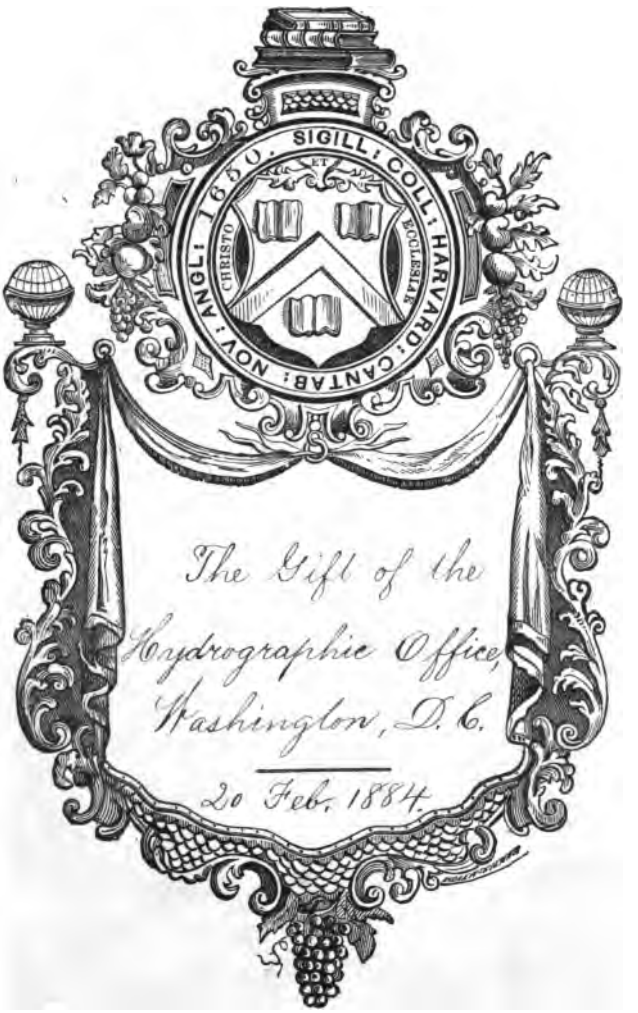

SIGILL: COLL: HARVARD: CANTAB: NOV: ANGL: 1650.
CHRISTO ET ECCLESIÆ
The Gift of the
Hydrographic Office,
Washington, D. C.
20 Feb. 1884.

MEMOIR

OF THE

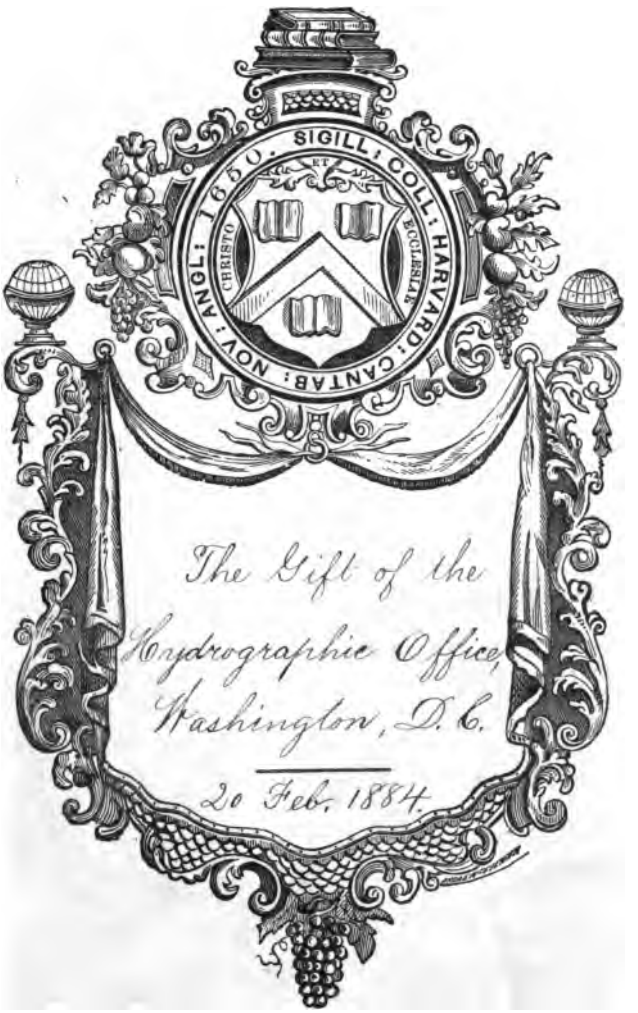
DANGERS AND ICE

With the compliments of the United States Hydrographic Office.

J.R.Bartlett, Commander U.S.Navy,
Hydrographer to the Bureau of Navigation.
Washington, D.C.

BUREAU OF NAVIGATION,
NAVY DEPARTMENT.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1868.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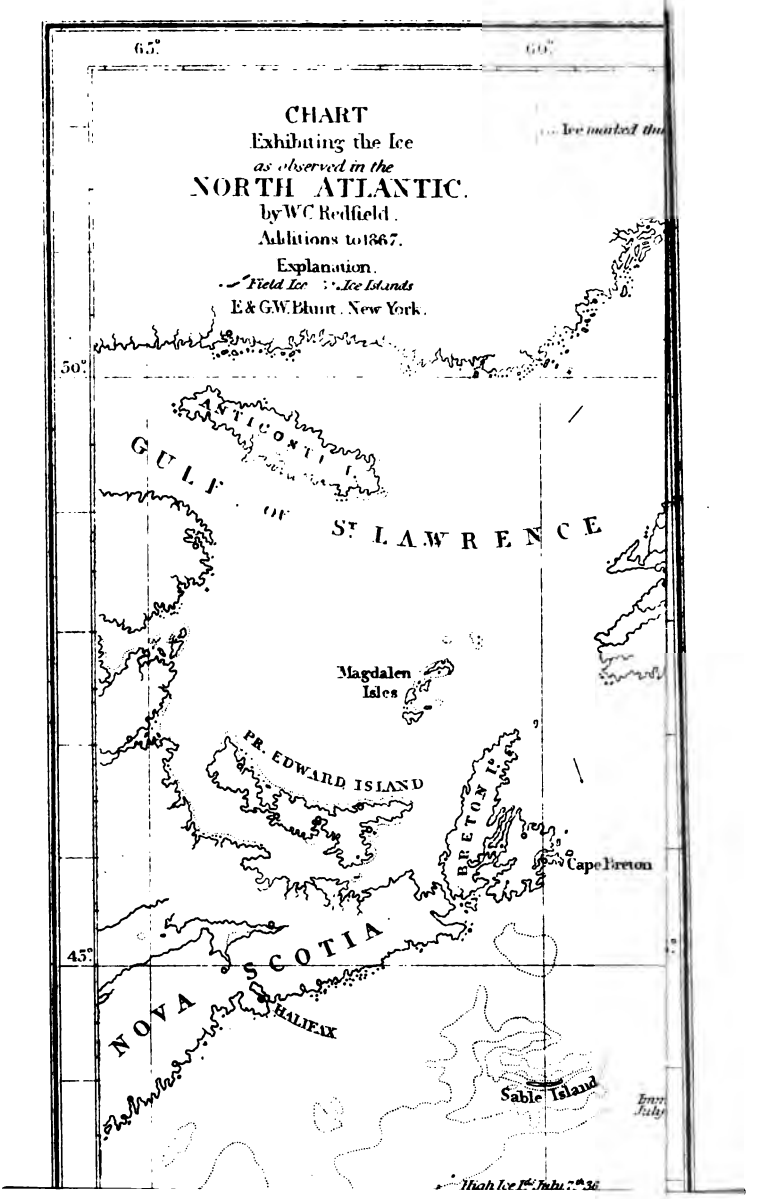
65°
60°
CHART
Exhibiting the Ice
as observed in the
NORTH ATLANTIC.
by W.C. Redfield.
Additions to 1867.
Explanation.
Field Ice
Ice Islands
E. & G.W. Blunt. New York.
50°
ANTICOSTI I.
GULF OF St LAWRENCE
Magdalen Isles
PR. EDWARD ISLAND
BRETON I.
Cape Breton
45°
NOVA SCOTIA
HALIFAX
Sable Island

O.

MEMOIR

OF THE

DANGERS AND ICE

IN THE

NORTH ATLANTIC OCEAN.

U.S. — BUREAU OF NAVIGATION,
NAVY DEPARTMENT.

15.

C.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1868.

PREFACE

THE compiler of this work has been indebted to the Nautical Magazine and Purdy's Memoir of the Atlantic, for most of the material used in its preparation. A few general remarks he feels bound to submit to the consideration of those into whose hands it may fall.

A great many of the expunged dangers have been reported on the ground that white or discolored water has been seen, and the rest has been inferred. We think it the duty of every shipmaster, when any of these indications are seen, that the deep-sea lead should be used. On this subject we substitute the opinion of a writer in the Nautical Magazine, page 599, vol. II.

To the Editor of the Nautical Magazine.

Sir—I was much gratified by observing a notice in your valuable work,* stating that Lieut. A. Sainthill, in 42° 37′ N. and in 41° 45′ W., on observing the water discolored, had tried for, and found soundings on rocky ground, with a depth of 100 fathoms: as, also by the opinion expressed by the Lieut., that soundings might be found from the meridian of 20° W. to the Banks of Newfoundland, because such opinion agrees with that I had formed from careful observation in June, 1828, and which I afterwards made public under the head of "Supposed series of submarine banks from Newfoundland to the English Channel."†

During our run across this part of the Atlantic, the changes of color from the dark blue of the deep ocean to shades of green, indicative of soundings, were so remarkable, that I was induced to reflect seriously on the probability that we we were passing over, alternately, submarine mountain and valley, the general direction of which was north and south. This idea became more and more impressed on my mind, as, from close and unwearied observation, I at last convinced myself, that the effect was not produced by molusca, &c., or by the alternations of the weather; in fact, I was fully satisfied, that, whatever may have been the cause, the effect was not subject to alteration, as the following instance will serve to explain:—On three consecutive days the water continued of a green-blue tint, very different from the general color of the deep ocean. On the first day, we had a gale, a heavy sea, and sunshine, until the afternoon, when it became cloudy, with a steam-like vapor resting on the surface of the water: second day, no sun, very cloudy, but horizon clear; third day, cloudy until noon, when the sun shone forth bright; in the evening, hazy. The color of the water during the whole time remaining unchanged.

I have therefore great hopes, if navigators would persevere in trying for soundings between England and Newfoundland, that detached submarine banks might be discovered, which, their positions being accurately determined, would become, as it were, so many beacons in the ocean, giving the longitude to those vessels navigated solely by account. The voyage to and from North America in this route would be greatly

* Nautical Magazine, No. 8, for October, 1832.

† United Service Journal, part i. 1830, p. 237.

facilitated, and these indicators would prove as convenient to the mariner as the milestone is to the traveler on the highway.

The subject being one of much interest, I may be excused for entering a little more into detail, in order to show the probability of the opinion being correct.

Philosophy informs us, that the colors of natural bodies arise from a quality, in virtue of which they reflect one component part of the solar ray more copiously than the others, and therefore affect the sight with the color so reflected. It seems obvious, therefore, that blue is the general reflected color of the ocean; and from its density near the surface being everywhere the same, it probably receives but one permanent color from above. Whatever different color is found in particular spaces of its surface, it may not perhaps be erroneous to assume, arises from some cause below; that is to say, from the nature of the bottom acting in conjunction with the light above. It may be remarked, however, that, although green-colored water betokens soundings, yet the bottom is sometimes found where the water is of a blue color; this probably occurs over rocky ground; it is observable at the Bermudas, where the water is extremely pellucid. It is well known, that the less vapory the atmosphere is, the darker is the color of the sky; on the contrary, the color of the ocean is darker when there are most clouds and other vapors in the air.

That various tints are often seen, particularly at sunrise and sunset, on portions of the ocean's surface, is admitted; but if a person looks on the opposite side of the reflections which cause these tints, he will find the water immediately surrounding the vessel precisely of the same uniform color, whether of a blue or a green shade, as had been observed before the tints became visible.

With respect to the probability of the change from one color to another being occasioned by molusca, from the blending of their prevailing tint with the blue of the ocean, I was, from careful examination, satisfied it could not proceed from that cause. To those seamen who have had frequent opportunities of observing the particular tints of certain portions of the ocean, especially within the tropics, by molusca and crustacea, the distinction would at once be striking on observing them, and the spaces of green-colored water on which we are now treating; of the former, on the voyage in which I made the observations, I ascertained the fact by drawing up a bucket of water in instances where the fluid appeared of a brown and of a greenish hue, and found, according to expectation, that it contained thousands of minute animalculæ of those particular colors. During the passage across the Atlantic, I tried this often, and in every instance the water drawn up was clear as crystal. Although in countless thousands, the medusæ did not cover the surface so closely as to give a tinge to the water like the molusca I had seen in the tropical seas; indeed, we sometimes passed over a long space without seeing one; yet the water preserved its color. They were evidently more numerous in the green-colored water than in the blue, but thousands were also seen in the latter.

I beg to be understood, that in making this communication, I do not mean to attach any credit to myself, from having originated the idea before Lieutenant Sainthill verified it, by obtaining a depth of 100 fathoms to the eastward of the Grand Bank, because it is extremely probable that many navigators may have formed a similar opinion long before my time, and, for aught I know, may have made such known publicly; undoubtedly, however, Lieut. S. is entitled to the praise of having determined, by practical proof, the probability of such an opinion being correct. My only ambition in this mater is, if possible, to be useful; it is enough, therefore, for me, Mr. Editor, to second you in directing the mariner's attention to a circumstance, which. if verified to the extent conceived, (or even less,) would become of the greatest benefit to us all.

AN ADVOCATE for the FREQUENT USE of the DEEP SEA LEAD.

And to this we may add the following extract from a Journal kept by one of our most experienced and intelligent shipmasters, Captain W. Skiddy. If all who thought they saw dangers would but adopt the course he has, the number on our charts would be much diminished.

"When in command of the ship Maria Theresa, in the year 1817, from Charleston, S. C., to New York, off Cape Hatteras, and near the edge of the gulf stream, a little before dark, observed breakers ahead, and what to us had the appearance of a sand-bank, of a yellow-brownish color, a little above water. We had at the time a fresh breeze with a considerable short swell, the spray of which was flying over the deck, and on the edge of the supposed bank breaking as on a beach. The weather clear, and knowing that no bank could possibly exist in this track, I determined to continue on sailing, then at the rate of 8 knots. On entering this patch, it became perfectly smooth, and as the ship proceeded through, it rolled up on the side like a thick oily substance about 6 inches in depth, showing the variegated colors of the rainbow. My opinion was that this substance probably was from some sick or dead whale; and had we not sailed through, but hauled up clear of it, no one would ever doubted its being a bank."

"June 14 and 15, 1839, ship Henry IV., N. Pacific ocean, two evenings passed through several remarkable white patches, which in the evening became much illuminated—we caught some in buckets, and found it would adhere to the hand and fingers, emitting a bright phosphorous light, which could be traced along the deck with the fingers; there appeared, however, on sailing through, some distance below the surface of the sea, a bright substance much larger, from which I concluded proceeded the smaller particles floating on the surface."

"This phenomenon I have only seen once previous, and that about fourteen years ago, a little to the N. E. of our present position, latitude 9° N., longitude 90° W.; it had every appearance of shoal water; no bottom with 120 fathoms."

No doubt some of the reported dangers exist, as the difficulty of finding a rock or a reef so far distant from the land that there can be no mark or range, is too well understood by practical men to require remark; and even near the land such dangers escape too often: for instance, the Dollabarat Shoal, which is the father of Tulloch's Rocks and other dangers, was passed over by Tofino, and only recently placed right by Capt. Vidal, R. N. And we have an instance in our own navigation, the most frequented part of it—that of Gangway Rock—in Long Island Sound. This rock lying in the centre of a narrow passage, was not known or buoyed until 1818, when a vessel struck upon it, and the writer of this went down to determine its position.

But, on the other hand, there is a disposition to magnify and create dangers where they do not exist. Clumsy bearings, guess-work,* or over-estimated distances, make many new shoals. See the case of the Bonetta Rocks—a vigia is reported; all hands are on the lookout for it; some think that something must be seen, *or they do not look out sharp;* a roller or beaker is seen—that is the danger, without examining whether it is over the carcase of a large

* In the case of the Helen Reef, off Rockall, the master of the brig Helen, which vessel was lost on this reef, and gave name to it, estimated the reef to lie six miles from Rockall. Capt. Vidal, who surveyed it, makes it 1710 fathoms, being a little less than one nautical mile and three-fourths.

fish or a partially sunken wreck or spar. It is then reported, and stands until some examination, such as has taken place within the last few years, is made, to settle the question. These modern surveyors diminish many dangers.

For the most valuable portion of this Memoir, he is indebted to his friend, W. C. REDFIELD.

G. W. BLUNT.

NEW YORK, *May*, 1848.

PREFACE TO THE FIFTH EDITION.

Since the publication of the Fourth Edition of this work, at the suggestion of Lieut. Maury, the U. S. brig Dolphin, Lieuts. Lee and Berryman, has been sent on two different cruises of exploration, and the results have been very important to navigation, as they have been the means of expunging many doubtful dangers from the Charts.

The article on the Gulf Stream, with the diagrams prepared by Professor Bache, Superintendent of the U. S. Coast Survey, will be found to be of great practical benefit to navigators, as it is the result of laborious examination, not of conjecture.

G. W. B.

July, 1854.

NOTE TO THE ELEVENTH EDITION.

On pages 19 and 20 will be found the remarks of the Rev. W. Scoresby, D. D., F. R. S., as to the dependence on the thermometer as a means of detecting the vicinity of ice, extracted from his voyage to Australia, in 1856. The knowledge and practical experience of this gentleman among ice entitle his article to the highest consideration.

G. W. B.

September, 1863.

The chart for which this Memoir was prepared contains the curves of magnetic variation up to the present date, and all the deep-sea soundings.

DESCRIPTION

OF THE

ROCKS AND BANKS OF THE NORTH ATLANTIC.

1.—TO THE NORTHWARD OF LATITUDE 50 DEGREES.

NUN ROCK, off Cape Rath, in lat. 58° 52½′, and lon, 4° 56′ W.—This rock, with the adjacent bank, was surveyed, under an Admiralty order, by Captain Ramage, in the Cherokee sloop of war, 1817. According to Capt. R., from the centre of the rock, over which there are but 15 feet of water, at low ebbs, Cape Rath bears, (by compass) S. 32° W., nearly 15 miles; Farout Head, S. 10° W., 18 miles; Whiten Head, S. 6° E., 21½ miles; the Stack, S. 85° E., 14 miles.

AITKINS' ROCK, N. W. Coast of Ireland.—Said to be in different longitudes, from 9° 53′ to 11° 14′ W., lat. 55° 15′ to 55° 19′, having only 4 feet water on it.

This we think does not exist. A most thorough examination was made in 1830, by H. B. M. gun-brigs Onyx and Leveret, directed by Capt. Vidal, under instructions from Capt. Beaufort, hydrographer to the Admiralty, and it could not be found.

BRAZIL ROCK, said to be in lat. 51° 10′, and lon. 16°, *does not exist.*

ROCKALL, lat. 57° 36′ 20″, long. 13° 42′ 29′.—This is a large high rock, of a conical shape. Its position was determined, and the bank around it examined, by Captain Vidal, R. N., 1831.

North of Rockall, 83 fathoms, is a rock usually uncovered.

Helen's Reef, bears from Rockall N. 73° 28′ E., distant 1710 fathoms. It is very dangerous; as in fine weather, with the wind from the eastward, it only breaks at considerable intervals. It is visible at low water, neap tides, in the trough of the sea.

High water, full and change, 5h. 30m Rise of the tide, 12 feet. The flood sets about W. by S. ½ S., true.

A bank, having on it from 85 to 192 fathoms, extends in a S. W. direction 125 miles from Rockall, and north from the rock 40 miles, 55 miles in width on the widest part.

LION'S BANK, in lat, 56° 40′, and lon. 17° 45′.—This bank was sounded by Lieut. Richard Pickersgill, in the brig Lion, in 1776, who found upon it from 290 to 320 fathoms. A vast quantity of sea-fowls were over it, and it probably abounds with fish. The position annexed is that given in the Requisite Tables. Dr. Forster, in his History of Voyages made in the North, says, "On the 29th of June, with 320 and 290 fathoms, Pickersgill found a sandy bottom, in 56° 38′ N., and 17° 44′ W., which induced him to call that spot *Lion's Bank;* and particularly so, as he found there, what is usually seen on all banks at sea, a vast quantity of sea-fowl, such as gulls, dumdivers, &c. Soon after this, he could no longer get any soundings, nor were there any more fowls to be seen. This bank is said to have been sounded on, a few years ago, by Captain Richmond, of Greenock.

The western edge of the Rockall Bank is identical with, and probably is, the Lion's Bank, according to Capt. Vidal. See the Chart.

KRAMER'S BANK, said to be in about 60° 57′ N., and 16° 40′ W., *does not exist.*

2.—BETWEEN THE LATITUDES OF 40 AND 50 DEGREES.

"The CHAPELLE BANK.—The French surveyors report that the Chapelle Rock, which is traced on several old charts, has long been the object of our ineffectual researches. We have found only, in the situation assigned to this rock, an insulated bottom, of small extent, having over it not less than 80 fathoms, and on which the sea may break in rough weather, but have little reason for believing that a danger exists hereabout.

"On the 30th of July, 1828, favored by fine weather, we traversed on the parallel of 47° 31′, at the rate of 3 or 4 knots, the horizon very clear, and the sea smooth. We lost bottom with 180 fathoms in lon. 6° 59′ 30″, at three-quarters past three a. m.; and thence continued to sound, in all directions, near the spot where the rock was said to exist. We at first obtained ground with the depth of 103 fathoms, but notwithstanding all our efforts we gained no less than 80, and this was in latitude 47° 33′ 47″, and longitude 7° 20′ 12″. The position of this sounding may be regarded as very exactly determined by lunar and chronometric observations.

"It was remarkable here, that at several miles to the west of this bank, a portion of a lower mast was found, 20 feet long, covered with long sea-weeds and shells, which, from a distance, appeared like a rock even with the water The weather was so favorable that on an approach, the object was found to be really a piece of floating wood; but had the weather been otherwise, so as to have prevented examination, it might have been supposed to be a *vigia*, or rock, even with the water."

CHAPELLE ROCK, 47° 43′ N. latitude 8° 4′ 30″ W. longitude.—This rock, which has been expunged, it appears, by the following from the Nautical Magazine, has re-appeared.

Abstract from the log of the brig Grace Darling, of Liverpool.—9th August, 1842. At 1h. 30m. p. m. breakers seen close to the vessel, and a sunken rock observed distinctly and repeatedly above water in the hollow of the sea, which clashed together and broke much. Supposed the rock might be about four feet below the usual sea level. It was witnessed by the whole crew of the vessel, which passed within her one length to windward of it, then going about 7½ knots. Supposed it to be the Chapelle Rock of 1786; its circumference appeared to be about 40 feet; it was of a sandy color like freestone, and no weed appeared on it. All on board were much alarmed. Latitude in, carried on from a good meridian observation, 47° 43′ N., and longitude reduced from chronometric observations at 9h. 30m. a. m. and 3 p. m., 8° 04′ 30″ W. The chronometer was No. 2050, by Mr. Henry Fordsham, from whom her rate had been obtained only nine days before, and its accuracy subsequently confirmed by excellent distances of sun and moon on the 27th August, and again by making Deseada on the 5th September. So the existence of the rock in the assigned position may be relied on.

JAMES TASKER,
Master of the Grace Darling.

DEVIL'S ROCK, lat. 46° 35′ N. lon. 13° 7′ W., Lieutenant Berryman saw nothing of it after a careful search. He found bottom at 2200 fathoms over its assigned position.

NEGRE'S ROCKS, lat. 48° 7′, long. 21° 0′, *do not exist.*—These rocks, said to have been seen in 1742, have been designedly omitted on the chart, from a conjecture that the back of a whale may have produced the appearance formerly described.

THE FIVE HEADS, in lat. 44° 15′, long. 19° 25′, *do not exist.*—Under this denomination the French chart of 1766 has a rocky shoal, some part above water, in latitude 44° 10′ and longitude 19° 25′. It is marked some minutes more to the north on the charts of M. Van Keulen. No account of it is, however, given either by him or Bellin: Nor, although sought after, has any account of it yet been found. It seems that Bellin, in his charts of 1757 and 1766, has given it on the solitary authority of Van Keulen. We shall erase it from the charts.

GREEVE'S LEDGE, said to be in latitude 44° 15′, longitude 25° 5′, *does not exist.*

WOODALL'S ROCK, near lat. 43° 20′, long. 25° 10′.—"Ship Indemnity, at sea, on her way from Demerary to England, 1829, at 30m. p. m. discovered a rock on her starboard beam, distant about three ships' length; the ship was then going at the rate of about two and a half miles an hour, with a heavy swell from the N. W. With each succeeding swell the rock was entirely covered, but at intervals it showed several feet above water, perfectly perpendicular. From the mast-head, it was seen to a great depth below water, and appeared to be in the shape of a cone. At the preceding noon the latitude by observation, was 43° 20′ N., and longitude, by chronometer, 25° 10′ W." *(Attested by the Captain, Mate and Passengers.)*

AMPLIMONT ROCKS, in lat. 42° 30′, long. 24° 5′.—In M. Bellin's Memoir of 1742, a danger is mentioned in latitude 42° 30′, and longitude 24° 5′, which was seen in 1735 by M. Guichardi, commander of the ship Dauphin, of Nantes. It has two points of rocks, separated, and 30 feet above water. He ascertained the height within a league of the danger, which appears to be the same as that called La Basse d'Amplimont, stated to be nearly in the same latitude and longitude. We have given it the position originally assigned by the Memoir. Some Englishman has called it by the name of Edward Knowle's Rock, by whom it is supposed to have been seen.

Extract from the Nautical Magazine, for October, 1842:—"On the 13th May, I sailed from Paimbœuf for Quebec, with the wind at N. E. We had a fine run to long. 19° 44′ W. On the 23d May, (at noon, in lat. 42° 41′ N. by two good observations,

and long. 24° 3′ W.) at 7h. 20m. p. m., I passed a rock within two ships' length. When I first saw it, it was a little before the larboard beam, and appeared like a ship's anchor-buoy. When it came on the quarter, I saw the sea-weed quite plain upon it, as did also the watch on deck. Another part of the rock we saw under water, about 8 or 10 feet from the rock we saw above water; at intervals it was covered and uncovered. We had not much swell on at the time; fine pleasant weather. At the time of passing the rock the ship was in lat. 42° 51′ N., and long. 24° 15′ W. The rock was seen a considerable time after we passed it. Wind at the time W. N. W., hip's head north, going 3 and 3½ knots per hour.

CHARLES WILSON."

THREE CHIMNEYS, in lat. 47° 54′ N., long. 29° 40′ W., Lieut. Berryman obtained bottom over its assigned position, at 1900 fathoms.

MARINER'S ROCK, lat. 46° 00′ N., long. 29° 37 W., Lieut. Berryman obtained soundings over its position, at 1760 fathoms. Saw no sign of a rock.

JAQUET ISLAND, said to be in lat. 46° 55′, and long. 39° 30′, *does not exist.*

BEAUFORT BANK, lat. 42° 37, long. 41° 45′.—Lieut. A. Sainthill, R. N., commander of the ship Beaufort, on returning from Jamaica, August 3, 1732, when in lat. 42° 37′, and long. 41° 45′, observed the water to be discolored; in consequence of which he twice tried for soundings, and found rocky ground at the depth of 100 fathoms. Lieut. Sainthill is of opinion that soundings might be found from the meridian of 20° west to the Banks of Newfoundland. See upon this subject the Nautical Magazine, Oct. 1832, page 393, and Oct. 1833, page 599. In April, 18 1, Capt. Simpson, ship Hudson, in long. 43° 2′ W., lat. 44° 46′ N., found 35 fathoms, mud.

DRUID'S REEF, in lat. 41° 19′, and long. 41° 25′, Lieut. Berryman sounded in 500 fathoms, no bottom, over its alleged position.

HERVAGAULT'S BREAKERS, in lat. 41° 2′, and long. 49° 23′, Lieut. Berryman obtained bottom over their assigned position, at 4580 fathoms.

DARAITH'S ROCK, lat. 40° 50, long. 54° 53′, Lieut. Berryman obtained bottom over its alleged place, at 2710 fathoms.

WATSON'S ROCK, lat. 40° 18′, long. 53° 40′, Lieut. Berryman sounded over its position, but found no bottom at 500 fathoms.

VIRGIN ROCKS, lat. 46° 26 30′ N., long. 50° 57′ 30″ W.—His Majesty's sloop Inspector was anchored about one hundred fathoms to the north-east of the shoalest part of the rocks, in the above position. The observations were made with a circle by Worthington and Allen, and two chronometers, the latter with a rate six days old from Halifax. Their meridian distance from Halifax was found to be 12 42′ 6″ E., and the longitude of the rocks depends on Halifax dock-yard, which is supposed to be in 63° 38′ 41″ W. of Greenwich. The Inspector lay at anchor forty-eight hours, during which time the above result was obtained from a series of observations with a well-defined horizon and favorable weather.

Mr. Rose describes the rocks as extending in an irregular chain or cluster, 800 yards, in the direction of N. E. by E. and S. W. by W., their breadth varying from 200 to 300 yards. They were distinctly seen under water, particularly a large white mass of rock, in 4½ fathoms, having 5 and 6½ fathoms round it. The shoal was traced in 7 fathoms, on detached rocks, near the edge of it, having deeper water between them. On the southern edge of the shoal, from S. E. to W., the depth increases gradually to 30 fathoms, at the distance of half a mile from the shoalest part. The same depth was found to the N. W. and N. E. of the shoal, at the distance of one-third of a mile, and also between N. E. and S. E. at the distance of one mile.

The bank on which the Virgin Rocks are situated, was found, by Mr. Rose, to extend four miles and a quarter, in an E. by S. and W. by N. direction, and two miles and three-quarters in its broadest part, the depth being regular from 28 to 30 fathoms. Beyond these limits the depth increased suddenly to 39 and 43 fathoms. The current was found setting to W. S. W. at the rate of one mile per hour over the shoal, with a confused cross swell.

The Manly, whilst at anchor on the bank, was obliged to strike her top-gallant masts; and the swell was so considerable, that the vessel rolled the muzzles of her guns under water. The Manly remained at anchor one night, and on getting under way in the morning, the chain cable broke in the middle, owing, it was supposed, to the violent friction which it had undergone against the rocks. In an easterly gale, which would be attended with the whole swell of the Atlantic ocean, no vessel could pass over these rocks. They lie in the direct track to Cape Race, Newfoundland the point which vessels bound to Quebec, generally endeavor to make.—*Nautical Magazine, Jan.* 1832.

SHOAL ON THE BANKS OF NEWFOUNDLAND.—"A shoal with only 21 feet water upon it was discovered by Jesse Ryder, master of the fishing schooner Bethel, (belonging to Province Town, Massachusetts,) on the Grand Bank of New-

foundland, in lat. 46° 30', having observed on the shoal and saw distinctly, it being a rock of about 100 or 200 feet surface; supposed to be about fifty miles east of the Virgin Rocks. Shoal bears from Nine Fathom Bank S. by W. by compass about 1¼ mile; discovered it accidentally while searching for the Nine Fathom Bank to fish on. Am certain it was not any part of the Virgins; for I afterwards saw them, and from my experience of the different fishing grounds, know this shoal to exist."

SABLE ISLAND.—The western Flag Staff at the principal establishment on Sable Island is in

Lat. 43° 56′ 33″ N.
Long, 60 3 16.7 W.

The eastern extreme of the Grassy Sand Hills is in

Lat. 43° 59′ 05′ N.
Long. 59 45 59 W.

The east extreme of the Sand Hills alone remains unchanged, from comparison with the observations of Admiral Ogle's officers.

No reason to find fault with their determination of latitude and longitude.

Two miles of the west end of the island washed away since they observed in 1828. This reduction, and consequent addition to the Western Bar, is reported to have been in operation since 1811, and seems almost certain to continue.

An opinion exists that the island is insensibly becoming narrower.

It is agreed by all that there has been no material change in the east end of the island within the memory of any one acquainted with it.

Western Bar can be safely approached by the lead, from any direction, with common precaution.

The length of the N. E. bar has been greatly exaggerated, but it is still amost formidable danger. It extends 14 miles from the island to 10 fathoms, and 13 miles to 6 fathoms; all within the last named depth being a line of heavy breakers in bad weather. Not far from the extremity of the bar the depth is 170 fathoms, so that a vessel going moderately fast might be on the bar in a few minutes after in vain trying for soundings. This bar, moreover, is very steep all along its north side, and is on these accounts exceedingly dangerous.

The reduction of this bar from its reported length of 28 miles to its real length of 14 miles, greatly lessens one of the objections to a light on the east end of the Island.

The people of the island frequently see the mail steamers passing the island, as well as other vessels, which, from their distance, were probably unaware of their proximity. *From Capt. H. W. Bayfield's Report, Sept.* 1851.

CASHE'S LEDGE.—The position of this shoal has been determined by Lieut. Charles H. Davis, U. S. Coast Survey; it is in lat. 42° 56′, long. 68° 51′ 30″.

East by compass 72 miles from Thacher's Island you get soundings upon the Fippanies, a bank of 8 or 10 leagues in extent from north to south, about six miles wide in the centre and the northern end; on the southern end two to two and a half miles wide. The depth varies from 27 to 46 fathoms, shelly and pebbles.

From the centre of the Fippanies, E. by N., 25 miles, will bring you upon Cashe's, on the shoal ground, which is on the eastern edge of the Bank; and is a flat white rock of from 200 to 300 feet in extent. Upon this rock there are 26 feet water.

South of the flat rock there is a gully, 90 fathoms water, which runs in upon the bank in a S. westerly direction. Upon the south side of this gully, three miles south of the flat rock, there is a shoal of 7 fathoms, from which the soundings run suddenly to 15 and 30 fathoms on all sides except the east, where it deepens suddenly to 80 fathoms.

N. by W. 9 miles from the flat rock there is another shoal of 14 fathoms; between this and the flat rock there are from 10 to 35 fathoms, rocky bottom: on the rocky bottom there is kelp of 45 feet in length; on the flat rock there is none.

(See Chart of the N. E. Coast United States, published by E. & G. W. Blunt.)

NANTUCKET SHOALS, extending from Nantucket Island.—These very dangerous shoals have been represented as extending nearly half a degree to the southward from the S. E. end of Nantucket Island; but it has been found by a survey, (1819,) made at the expense of Mr. E. M. Blunt, of New York, that they are by no means so extensive as they have heretofore been represented; and that the southern extremity of the old shoal, with 9 fathoms water, is in about 40° 57′ N., and 69 58′ W

NEW SOUTH SHOAL.—This dangerous shoal was discovered and surveyed by Lieut. Charles H. Davis, U. S. Coast Survey. It has on it only 8 feet in places, and bears from the middle of the Old Shoal from S. 3° 28′ W. to S. 16 42′ E., by compass, distance $6\frac{4}{10}$ miles. It is $2\frac{3}{10}$ miles long from east to west; and its greatest breadth from north to south, nine-tenths of a mile.

Between it and the Old Shoal there are from 4 to 18 fathoms water; but to the north and east there are ridges of only 20 to 24 feet water, to the extent of about

three miles from the New Shoals. Lieut. Davis states that deep water intervenes between these ridges, and the soundings on the ridges were very irregular.

The tide rips show that two, and perhaps three, lines of shoal ground are near each other, in parallel directions. The latitude of the centre of the New Shoals, is 40° 57′ 50″ N., longitude 69° 51′ 40″ W., and bears from Sankaty head, S. S. E., 19½ miles.

GEORGE'S SHOALS.—These shoals, which were laid down in different positions on all the old charts, were originally surveyed in 1821 at the expense and suggestion of Edm. M. Blunt, by Edmund Blunt; Commodore Isaac Hull assisting with the loan of a vessel to accompany the Orbit. Since that time an extended and minute survey has been made by Lieut. Charles Wilkes, U. S. N., under an act of Congress, whose position of the shoals does not vary materially from those of the Orbit. For the full report, see American Coast Pilot. From Lieut. Wilkes' report we take the following:

"The shoalest water found on any part of the bank was 2½ fathoms, or 15 feet, reduced to low water; and this is only to be found in two small places, viz:

Lat. 41° 40′ 13″ Long. 67° 44′ 10″
Lat. 41 40 33 Long. 67 44 30

"The whole of the shoal is composed of hard sand and spits—fine sand on the shoalest places, and coarser as the water deepens, until it becomes large pebbles without sand."

"The rise and fall of tides is 7 feet, extremely regular, the first part of the flood setting N. N. W., the latter N. by E., and ebb S. S. E. and S. by W. The flood runs 4½ hours, ebb 5½ hours; greatest velocity two and six-tenths of a mile, from half an hour to two hours in changing, going round with the sun on from north by way of east. The wind has but little effect on the velocity. High water, at full and change, at 10 o'clock 30 minutes. Variation of the compass 8° 15″."

CULTIVATOR SHOAL.—This shoal has been examined by the United States Steamer Don, Commander Chandler, U. S. N., by order of the Chief of the Bureau of Navigation, Commodore T. A. Jenkins, U. S. N.; it is 5 miles in extent, in a N. by W. and S. by E. direction, and has three fathoms on its shoalest part, which is in Lat. 41° 37′ 30″ N., Long. 68° 11′ W. The northern end is in Lat. 41° 39′ 30″ N., Long 68° 2′ W.; the south end is in Lat. 47° 34′ 30″ N., Long. 68° 10′ W.

3.—BETWEEN THE LATITUDES OF 30 AND 40 DEGREES.

DÆDALUS ROCK, off Cape St. Vincent, in about 36° 30′ N., and 9° 16′ W.—The old charts of the Atlantic indicate a danger at the distance of 12 or 15 leagues to the S. W. of Cape St. Vincent. This danger was omitted in the French chart of 1786, and subsequently in other charts, from the supposition that, if it really existed, it must have received some modern confirmation. But it seems from information communicated by Capt. Taylor, of the brig Laurel, of Whitby, that, in about 1813, the Dædalus transport struck on the rock, and received so much damage as rendered it necessary for her to put into Lisbon for repairs—Capt. Taylor was in the fleet when the Dædalus struck.

Added to this, the brig Briton, Capt. Stokes, was lost, in consequence of striking upon the rock, in December, 1821. After she struck, she swung off, and then immediately tried for soundings, but got none. On finding the vessel sinking, the people took to the boat and were picked up by another vessel. Capt. Stokes had not seen Cape St. Vincent, but supposed it, at the time, to bear N. N. E. ½ E. 28 or 30 miles. This information has been communicated by Capt. Livingston, who says, "This information was given to me in Malaga, in September, 1822, by Capt. T. Tankersly, of the schooner Lord Mulgrave, of London. Capt. T. added, that he had met with another master, (name forgotten,) who said he had observed the sea-weed on this rock, got out his boat and held on by some of the weed. He supposed the rock to be about 50 yards in circumference."

The preceding information is from Capt. Livingston, who also says, "I was some years since informed by an old man of color, a native of Goa, who was steward of a vessel I then commanded, that while he was cabin-steward to Sir Edward Pellew, while captain of H. M. ship Indefatigable, she struck on a rock off Cape Finisterre. This, I understand, has been denied, and it appears truly; for I have now information on which I can rely, from a very respectable naval officer, whose name I do not consider myself at liberty to mention, that the Indefatigable, when commanded by Sir Edward Pellew, actually struck on the rock, or a rock, off Cape St. Vincent, and received some damage. I had no doubt before, that she had struck somewhere, as I had perfect confidence in the old steward's veracity: the error was in memory only."—*(Letter 28th Oct. 1822.)*

The existence of this rock was confirmed on the 6th of March, 1839, by Mr. John Ayes, commander of the schooner Tantivy, of Plymouth At 9h. 30m. p m. this vessel

on her voyage from Zante, passed close to the eastward of it; it was not seen till close aboard, and not avoided without difficulty. There was a swell from the N. W. breaking over it, and a sheet of foam, about 20 to 25 fathoms in circumference. The Tantivy stood in N. N. E. on the starboard tack, till 7 next morning, then tacked to the southward, passing the Cape at the distance of about two miles. The rock was thus estimated to lie considerably to the eastward of its position as shown by chart, and to bear about S. S. W., true, 37 or 40 miles from the Cape.

FALCON ROCKS, to the northward of Porto Santo.—Least water 4½ fathoms, 8 miles N. N. W. from the N. E. point of Porto Santo.

The EIGHT STONES, to the northward of Madeira.—Said to be between the latitudes of 34° 30′ and 34° 45′, longitude 16° 40′ W., *do not exist.* A full examination has been made of the different places in which it has been located by several British men-of-war and surveying vessels, at different times, and no trace of the shoal could be found. See the plan and tracks in the Nautical Magazine of July, 1837.

Captain Fitzroy, R. N., says, "On the 3d of January, 1832, we were occupied in looking for the Eight Stones; but nothing was seen to indicate either rocks or shoals, or even shallow water. The sun was shining brightly on a deep blue sea of one uniform color; no sounding could be obtained; and had there been a shoal or rock within seven miles of us at any hour of that day, it could not have been passed unnoticed. So many vessels have searched, in vain, for this alleged group of rocks, that their existence can now hardly be thought possible."—*Voyage, Vol.* II., 46.

Lieut Berryman made a thorough search for them, and sounded at regular and short intervals, obtaining bottom at 2298 fathoms. He saw no indications of their existence.

JEAN HAMON'S ROCK, said to be in lat. 36° 54′, long. 19° 49′, *does not exist.* Lieutenant Berryman could find no bottom over its position, with 2100 fathoms line.

WHALE ROCK, said to be in about lat. 38° 46′ long. 25°, *does not exist.*

TULLOCH REEF, said to be in about 37° 27′ N. and 24° 45′ W., *does not exist.*

FORMIGAS and DOLLABARAT'S SHOALS.—From the survey of Capt. Vidal, H. M. ship Styx, it appears that the Formigas are placed three miles too far to the westward on the charts.

Dollabarat's Shoal bears from the Formigas, S. 44° E., true, distance three and a half miles, and is in lat. 37° 13′ 30′ N. Captain Vidal says, "We anchored close to it, and scoured the ground with our boats. It is a fearful danger, the least water we found on it was 11 feet, at low water. It is also a most insidious danger, only showing itself when there is a high swell or sea."

"We searched in vain for Tulloch's Rocks, and I think he saw the Formigas, and shoal connected with them, and none other."

ST. MARY'S BANK, reported on the authority of Capt. Livingston, who saw white water, *but did not sound.*

JOSYNA ROCK, in lat. 31° 40′, and long. 23° 45′, *does not exist.* This place was searched over with from 100 to 800 fathoms line, without finding either bottom or rock.

CHANTEREAU'S SHOAL, in lat. 38° 16′, and long. 39° 49′.—This shoal, which has been described as a white rock, was seen by Captain Chantereau, of the ship L'Auguste, in coming from Martinique, 6th September, 1721, when the sea broke on it very much. It was again seen by Lieut. Edm. Scott, commanding the Princess Elizabeth Packet, 24th April, 1828, and that gentleman has given the following account of it: "On the 24th April, 1828, at 3 p. m., I came on deck, and immediately observed the water around the ship very green, and with every appearance of being in soundings; and on looking before the starboard beam, saw under water, at the distance of two cables, what evidently appeared, to the master and myself, to be a white sand-bank or rock, which the water did not then break on, but it appeared so very plain that there could not be much water on it. In extent it was about one or one and a half cable E. by N. and W. by S., true, and about half a cable in breadth.

Immediately on observing the shoal, I ordered the lead and line up; but ere it was ready the color of the water had changed to a deep sea-blue, when it was evidently useless to sound. At that time we were about a mile from the white spot; we had at the time a good breeze, but very little swell of the sea. I obtained two sets of lunar distances the day before; and at noon on the 23d had taken myself, with a sextant, the meridian altitude very particularly, in order to obtain the time correctly for lunar distances on the opposite side of those previously taken, and which I did obtain, and made the latitude of the shoal 38° 16′ N., and by the mean of the lunars, which differed very little, 39° 48 49″ W. Owing to a defect in my chronometer, I was not enabled to bring forward the longitude by it, but every care and attention in my power has been taken to give its correct situation."

BRETON'S ROCK, about lat. 39° 40′, and long. 41° 35′.—Lieutenant Berryman obtained bottom over its position, at 2500 fathoms.

This danger was again seen in 1816, by the ship Tiger, on her passage from Barbadoes to Liverpool. The letter of a passenger states that, "on the 14th of March, at 10 a. m., a smart breeze from the S. W., with studding-sails set, going 7 knots and a half an hour, steering E. by N., true, in lat. 39° 40′, long. 41° 40′, we passed over a very agitated rumbling sea. Under our starboard bow, in appearance about the circle of a mile, was a small field of dark brown rock-weed, apparently a confirmed fixture: entangled with the weed were two pieces of spar, seemingly very much decayed. I am positive that this is a danger which ought to be carefully avoided by all ships coming to Europe from the West Indies and America, as it lies directly in the track."—*(Newspaper, April 15, 1816.)*

We are still at a loss for the position of the shoal; as it does not appear to have yet been correctly ascertained.

MUNN'S REEF, expunged on the authority of Com. R. Owen, R. N., who searched for it in vain in 1835.

POTOMAC SOUNDING'S, lat. 38° 10′, long. 67° 25′.—On the southern side of the Gulf stream, in the situation given above, soundings at 90 fathoms were found by Captain Smith, in the ship Potomac, of Alexandria, U. S., June, 1838, as shown in the chart.

Lieutenant Lee sounded with 400 fathoms of line, but obtained no bottom. Lieutenant Berryman, in 1853, made a thorough search for this shoal, and got bottom at 2750 fathoms.

BERMUDAS.—These are fully described in the American Coast Pilot. A cast iron light house, 365 feet above the level of the sea, containing a revolving light, has been erected on the island, on Gibbs' Hill.

The dangerous rocky reefs extend, in some parts, eight leagues from the islands, and render them very difficult of access. What renders the approach more dangerous is, that the land is low, and the currents around are variable.

The banks to the S. W. were surveyed, in 1829, by the officers of H. M. sloop Columbine; according to whom the northern extremity of the Inner Bank lies in 32° 6′ N. and 64° 53′ W.; the S. W. in 32° N. and 65° W. The least water found was 2½ fathoms, corally and rocky bottom. On the edges are 40 fathoms. To the S. W. of this bank is another, called the Outer Bank, the N. E. end of which is in lat. 31° 59½′ long. 65° 2½′: the S. W. end in 31° 57′, and 65° 5′. The least water found on this bank was from 33 to 47 fathoms, rocks and coral.

NYE'S SHOAL, said to have been seen in 1826, in lat. 31° 15′, long. 55° 50′, *does not exist.*

The Taney cruised about this place for eight days, also sounding, without any traces of the shoal, or bottom

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4.—BETWEEN THE LATITUDES OF 20 AND 30 DEGREES.

GOMBAUD'S ROCK, in lat. 23° 15′, and long. 32° 25′, *does not exist.*—Search and soundings were made for it two days. Bottom was obtained at 2200 fathoms.

MOURAND'S BANK, in lat. 24° 34′, and long. 65° 10′, *does not exist.*—Lieutenant Lee searched five days for this bank, and sounded over its assigned position at 1000 fathoms, no bottom.

GUIGOU'S BANK, in lat. 20° 50′, and long. 66° 45′.—M. Bellin, in the Memoir of his chart of 1742, describes this to be "a rocky bank, about 45 leagues to the northward of Porto Rico, upon which a Dutch vessel was lost in 1701, and that it had also been seen by a French vessel." Another manuscript in the Depot de la Marine, confirms this account, and adds, "The commanders of both vessels declare, that a little island of sand appears on the middle of the bank, in latitude 21° 24′, and that the bank is three leagues in length. It also appears from the deposition of Christopher Whipple, commander of the Anna, of Rhode Island, that he was wrecked on the 17th November, 1733, upon a shelf, from 30 to 40 leagues to the northward of Porto Rico; which there is little doubt must be the same. In the Marine Depot of Paris there is a manuscript entitled, "Plan of the Shelf which was discovered by Capt. Michael Guigou, of Seine, in Provence, on a voyage from Cape Francois, in the ship La Concorde, February, 1688." On that plan it is placed at 45 leagues to the northward of Porto Rico, somewhat nearer to the western than to the eastern end. It has been subsequently represented in different situations. That given above is the probable mean.

INGLEFIELD BANK, in 29° 42′ N., and 80° 17′ W.—This bank, lying about 66

miles east of St. Augustine, was discovered by Captain S. Hood Inglefield, on the 26th of May, 1810, in latitude 29° 42′ N., longitude, by account, 80° 12′; by chronometer, 80° 17′, and by lunars, 80° 18′. Sounded in 25 fathoms, black sand; hence, steering N. by W. ½ W. course, made good, had regular soundings, 24, 25, and 27 fathoms, speckled and broken shells, until 6 p. m. on the 27th, when no bottom could be found. Noon, on 27th, lat. 30° 5′ N., long. by account 80° 25′ W., by chron. 80° 25′. On the 26th the current set W. N. W. one mile an hour: at 4 p. m. on the 27th, no current. On the 28th, in lat 31° 5′, and long. by chronometer 79° 46′, current ran N. N. E. 1¼ mile an hour.—*Communicated by Lieutenant Jn. Evans*, R. N.

5.—VIGIAS BETWEEN THE EQUATOR AND THE PARALLEL OF 20 DEGREES.

HANNAH'S CORAL SHOAL, lat. 10° 7′, long. 27° 32′.—This shoal was discovered by Captain Thomas Fanning, of the brig Hannah, on the passage from Rio Janeiro to Trieste, June 25, 1824. It appeared to extend 150 fathoms, N. E. and S. W., with two branches or arms from it on the N. W. side, and one on the S. E. side. Sounded in 15 fathoms, granulated coral, on the S. W. part, but supposed it much shoaler on the N. E. points, as the weed was plainly to be seen, from the mast-head, on the surface of the water. Its latitude was found to be 10° 7′ N., and longitude about 27° 32′ W. The latter was deduced from lunar observations taken the day before but as a strong westerly current, (the equatorial) was experienced, it cannot be depended on within 20 miles. The latitude may be considered correct.

MARIA AND BONETTA ROCKS,* Madeline Reef, Warley's Shoal, French Shoal, Cæsar Breakers, Bouvet's Bank, &c.—Extracts from a letter addressed to the Secretary of the United States' Navy, by Lieut. Charles Wilkes, commanding the the South Sea Surveying and Exploring Expedition, and dated on board the sloop Vincennes, at Rio Janeiro, Nov. 27, 1838:

"It will be presently seen that the squadron effected the examination of the supposed position of ten or eleven shoals or dangers, the detailed accounts of which were formerly given in this work, their assigned positions in the charts, and the non-existence of which has apparently been proved. The search in the first instance, was for St. Anne's Shoal, long since expunged, and which, of course, was not found; but hereabout they fell in with a large cotton-wood tree, 120 feet long and 15 in circumference, which was, at first, reported as a shoal, and with a rough sea, in passing, it might have been mistaken for one." Commander Wilkes says, "I have little doubt but similar trees have occasioned the frequent reports of vigias or shoals being in existence hereabout. Our position at this time was in latitude 37° 0′ 37″ N., and longitude 40° 41′ 54″ W., and where any floating bodies drifted by the Gulf Stream would probably have been deposited, as here is little or no current, and that variable."

"The first reported shoal laid down on our route upon the charts was the Maria Rock, in latitude 19° 45′ N., and longitude 20° 50′ W., which we stood for, and hove-to near the position, until we had ascertained our situation correctly, by careful observations. The vessels were then spread, and the course marked to run directly over the spot; the surface of the ocean visible at the time from the squadron, was not less than 60 miles in circumference, with every opportunity which the clear weather could afford, and sufficient swell of the sea to have caused breakers on any shoal within 15 feet of the surface. Nothing, however, was discovered, and no bottom could be found with 300 fathoms of line.

"The next position we examined was Bom Felix Shoal, said to be within 30 miles of the Maria Rock; this was searched for in the same manner, but were equally successful. We then stood for the place assigned to the Bonetta Shoal, to the eastward of Bonavista, said to be in latitude 16° 32′ N., and longitude 20° 37′ W. We in like manner hunted for this, and, after exploring the locality of its position on the chart, I steered on the course of its reported bearing, E. by N. from Bonavista, until nearly up with the Hartwell Reef, lying in sight of Bonavista, which has, without doubt, been taken for, and reported as, the shoal called Bonetta.

"Our inquiries at St. Iago assured me that the Madeline (the vessel last wrecked) was cast away on the Hartwell Reef, which has been reported as the Bonetta Shoal.

"I am well satisfied that the positions assigned to the above three shoals on the chart, and their vicinity, are free from all dangers. I am of opinion, also, that the particular and indefatigable search made by Captain Bartholomew, of H. M. S. Laven,

* On the subject of these rocks, which are no doubt the Hartwell Reef, see vol. x, p. 816, vol. xi, pp. 46 and 753 of the Nautical Magazine.

and the opportunities afforded me of covering, with the squadron of five vessels, so large a space, at the same time, ought to be sufficient evidence that no such dangers exist as they are laid down in those positions, and should cause them to be obliterated from the charts.

"From Port Praya we steered for Patty's Overfalls, as laid down in the chart, in latitude 11° N., and longitude 24° 30′ W., and had a good opportunity of examining their locality. A few rips were observed within a degree of the situation assigned them, but little or no current was found; and I feel confident in asserting that no danger exists in this vicinity, as we were becalmed in the position, and in close proximity to it for 48 hours, the squadron as usual being spread apart, and having a broad expanse of ocean under view. Owing to contrary winds it was some days before we reached Warley's Shoal, said to be in lat. 5° 4′ N., and long. 21° 25′ W. This point was also carefully examined, but no shoal, or appearance of shoal water, or any danger discovered.

"Our next examination was of a French shoal, said to be (as laid down) in lat. 4° 5′ N., and long. 20° 35′ W. This was also examined, and no danger or appearance of shoal discovered. From this point I took advantage of the southerly wind, and proceeded east; which carried me as far as 13° of west longitude, and over the position assigned to the shoal by the French hydrographers, to enable me to cross the equator eastward of the 17th degree of west longitude. We succeeded in crossing the equator in that longitude on the 5th of November, and then stood for the Triton's Bank, said to be in latitude 0° 32′ south, and longitude 17° 46′ W. When within a short distance of its position the squadron hove-to, for the purpose of ascertaining our position accurately; after which a course was steered nearly west. Being at the time well to the eastward, we ran on a line due east and west over it; the vessels of the squadron being spread about three miles apart, on a line north and south. We did not, however, find it in our progress, or any bottom or indications of soundings; no *discoloration* of water was visible, or change of temperature, although the line extended 30 miles east and west of its reported position; after which we again stood to the north, and ran over a vigia as laid down on the charts, but none such was found in existence.

"Our next examination was for Bouvet's Sandy Island, which was, in like manner, carefully searched after, in and around its position, as laid down on the charts, but our search was equally successful."

[Lieut. Lee made a careful search and sounded with 1500 fathoms line, no bottom, without any appearance of shoals or dangers.]

"Finally, search was made in and about latitude 2° 43′ S., and longitude 20° 35′ W. Extending to the N. N. W. of this point a distance of 30 miles hereabout, having been assigned as the situation of the sub-marine volcano reported by Admiral Krusenstern, which it was supposed might have left a shoal. This locality was twice run over in different directions, and carefully examined, with the squadron in open order, but none such was found in existence."

"Lieut. Hudson, of the Peacock, having separated from me on the 16th of October, proceeded on a different course in search of the same shoals which we were looking for, but was equally unsuccessful in finding any, as appears by the following extract from his report to me, which affords further evidence if it were needed, of their non-existence:

"Having separated from you on the 16th October, it was not until the 23d that I had worked up to the Warley's Shoal; and at eight o'clock that night I was directly on the spot where it was laid down on the chart. We placed good look-outs, and kept our patent lead going for 50 miles before reaching the location of this shoal as laid down on the chart; also observing our drift at night, in hope of sweeping over it at early day-light. I continued cruising in this vicinity in various directions, getting casts of lead in from 50 to 100 fathoms, without finding bottom. I now continued my examination, and after having swept over a circle of 40 or 50 miles in different directions, am perfectly satisfied that Warley's Shoal exists no where in the neighborhood laid down on the chart.

"I then proceeded for the French Shoal, with the wind ahead, (S. by W.) where I arrived on the 25th of October, and continued cruising all the following day, with a fine breeze, immediately over the location of the shoal as laid down, and in every direction for miles in its vicinity. After thus thoroughly searching the *English* locality of this shoal, I directed my course for the French position, 76 miles distant, making nearly an east course, with look-outs and the lead going, until I had run immediately over and around the spot, sailing in various directions a distance of 40 miles, without effect.

"I then made the best of my way for the Triton Bank, with the wind veering and hauling from S. S. W. to S. S. E., and passed the equator on the night of the 3d of November, in long. 17° 40′ W., and continued over and around the locality of that

bank until the morning of the 5th, getting casts of the lead during the time from 50 to 250 fathoms, up and down, without finding bottom. I have, in our search, fully satisfied myself, and hope our examination will prove equally so to you, and all others, that these shoals do not exist."

Lieut. Lee obtained bottom over its alleged position, at a depth of 2840 fathoms

ST. PAUL'S ISLETS, latitude 0° 55 30″ N., longitude 29° 22′ 30″ W.—These islets were surveyed by Capt. Fitzroy, of H. M. S Beagle, in 1832.—See plan published by Admiralty, 1841.

Captain Fitzroy, from his observations, places the summit of Penedo in lat. 0° 55′ 30′, and long. 29° 22′. The variation here, on the 16th of Feb., 1832, was 9½° W. Temperature of the air and water, 82°. Wind S. E. The rocks were seen on the horizon at sun-set of the 15th. They appeared extremely small at about 8 miles distant. At day-light next morning two boats were seen to land upon and examine them, while the Beagle sailed around, sounding and taking angles. Good observations were made during the day, as the sky was clear and the water smooth.

The multitude of birds which covered the rocks was astonishing, and they suffered themselves to be kicked about and killed with sticks; at the same time those on the wing even darkened the sky. While one party were scrambling over the rock, a determined struggle was going on in the water, between the boats' crews and sharks. Numbers of fine fish, like the Groupars (or Garoupas) of the Bermuda Islands, bit eagerly at baited hooks put overboard by the men; but, as soon as a fish was caught, a rush of voracious sharks was made at him, and notwithstanding blows of oars and boat-hooks, the ravenous monsters could not be deterred from seizing and taking away more than half the fish that were hooked.

At short intervals the men beat the water with their oars all round the boats, in order to drive away the sharks; and for a few minutes afterwards the groupars swarmed about the baited hooks, and were caught as fast as the lines could be hauled up,—then another rush of sharks drove them away; those just caught were snatched off the hooks; and again the men were obliged to beat the water. When the boats returned they were deeply laden with birds and fish, both welcome to those who had been living on salted provisions.

"From the highest point of the rocks, which is 64 feet above the sea, no discolored water, nor any breaking of the sea could be discerned, apart from the place itself; and from the soundings taken in the boats, as well as on board the ship, I conclude that it is unconnected with any shoal, being merely the summit of a steep-sided mountain rising from the bottom of the ocean. A slight current was setting to the westward, not amounting to a mile an hour."

BLAESDALE'S REEF, in about 0° 57′ N., and 41° 6′ W.—On the 15th of October, 1819, the brig Richard, of Ulverston, Captain Blaesdale, struck on a coral reef, in about 0° 56′ or 0° 57′ N., and longitude, by account, beyond 41° W. In fine moderate weather, the ship going at the rate of three knots, at 6 p. m., grounded and remained fast about ten minutes. The water was smooth, and no breakers seen. Upon sounding a few minutes after, no bottom could be found at 125 fathoms. The vessel drew 11 feet water, and in one hour there were 18 inches of water in the well. On a subsequent survey at Para, three holes were found, each about the size of a man's hat, and nearly through the vessel's bottom, and several large pieces of white coral, as large as a man's hand, were found sticking in different parts.

Lieut. Lee obtained bottom over its position, at a depth of 2980 fathoms.

LE HUBY'S REEF, 0° 4′ N. to 0° 9′ S., about 44° 44′ W. longitude.—Extract from the Journal of Captain Le Huby, of the brig Les Jumeaux:—*(Nautical Magazine*, 1839.)

"Sailed from Maranham for Gaudaloupe on the 30th October, 1838, at 2h. a. m.—On the 1st Nov., at 7h. 30m., the wind being easterly, with light breezes and fine weather, I perceived ahead of the ship a remarkable change in the water, which had become a whitish green, with a chopping rippled appearance, and breaking in the direction of our course, which was then N. by W. The ship was surrounded by eddies, and the large spots of discolored water made me conclude that I was on a shoal, causing me some uneasiness on account of our position. At 8 o'clock I sounded in 19 fathoms, rocky bottom. Continuing the same course, and under the same circumstances, the ship going two knots, at 9 sounded in 21 fathoms, coral bottom; at 10 sounded in 23 fathoms, the same bottom; at 11 sounded in 28 fathoms, same bottom; at 12h. 20m. p. m., after an observation for latitude, sounded in 32 fathoms; at 1 o'clock sounded in 90 fathoms. The sea became smooth, and re-assumed its natural color.

"Latitude at noon, by a very good meridian altitude, 0° 4′ N. The longitude, determined by a good set of observations taken at 9 o'clock with a chronometer of Breguet, gave at noon 47° 4′ W. of Paris."

From this it appears that the shoal over which I had passed extends from 0° 9′ S. to 0° 4′ N., in a S. by E. and N. by W direction; and from my examination of this spot, the sea being much agitated, and breaking at intervals in a N. E. and S. W. direction, I think that the shoal may be a continuation of the Vigia Manoel Luiz, and the breakers seen by the Portuguese Captain da Sylva.

Without being able to ascertain whether it was so shoal in any part as to bring any vessel up, it must be dangerous in bad weather from the violence of the sea. My first cast of the lead was at 50 miles N., 33 W. of the Vigia Manoel Luiz, the position of which has been determined by Admiral Rouissin.—*Annales Maritimes.*

DELAWARE SHOAL, eastward of Trinidad.—Captain Ross, in the brigantine Delaware, from Charleston, on the 16th Sept., 1839, at noon, in latitude 10° 38′, struck soundings in 37 fathoms, shells and sandy bottom. At 3 p. m., steering south, passed over a rocky bank, having 5, 7, and 10 fathoms, and bottom plainly seen: inferred from the distance run that the latitude of the shallow part of the bank must lie in lat. 10° 37′ N., long. by chronometer 60° 3′ W. At 3¼ p. m. had 70 fathoms of water.

MARTIN'S REEF, latitude 16° 42′ N., longitude 58° 53′ W.—Lieutenant Lee searched two days for this bank, and made many soundings, one of 3200 fathoms, without finding bottom.

CLOWE'S REEF, to the northward of Porto Rico, lat. 19° 17′, long. 65° 50½′.—An American schooner, in 1817, struck on a rock to the northward of Porto Rico, in between 19° and 20° North. This was, probably, the same danger on which, some time after, the brig Robert, Captain Baxter, struck, and remained several hours. The reef, which has been variously represented on the charts, was seen by Capt. Clowes, in the ship Caledonia, on the 24th of April, 1825; and Capt. C. assigns for its situation lat. 19° 17′, and long. 65° 50½′. It is about a quarter of a mile in extent from east to west, with very little water on it. A quantity of sea-weed was seen at each end, which appeared to be drifting to the S. W. The ship was within a mile of the reef.

ST. ESPRIT REEF *does not exist.* It was searched for by order of Sir George Cockburn, by H. M. ships Ariadne, Sapphire, Vestal, Forte, and Victor, in 1834, and could not be found. See plan in Naut. Mag., Nov., 1834.

ICE IN THE NORTH ATLANTIC.

BY W. C. REDFIELD.

Of the various dangers which beset the path of the mariner, perhaps there are none which excite to more vigilance than the known or expected proximity of ice. In some frequented portions of the Atlantic Ocean the ice appears almost every year, in the various forms of field ice, floes, and massive ice-islands, drifted from the arctic regions by the constant action of the polar currents. These ice-bearing currents, in flowing towards the south, must necessarily incline towards the western limits of the ocean, owing to the increased velocity of the diurnal rotation of the earth's surface as we depart from the poles; a law well understood as regards the currents of *air* which form the trade winds. Hence it is that on and near the Banks of Newfoundland these ice-currents are found to cross the usual track of vessels bound from the ports of Europe to Northern America.

The quantity of ice which appears on this route of navigation in different years, is exceedingly various. It is sometimes seen as early in the year as January, and seldom later than the month of August. From March to July is its most common season. It is found most frequently to the west of longitude 44°, and to the eastward of longitude 52°; but icebergs are sometimes met with as far eastward as longitute 40°, and in some rare cases, even still further towards Europe.

Experience has shown that the proximity of ice is far less hazardous than rocks and shoals, and this floating danger would be still less formidable were it not for the fogs and mists which it often causes. The *thermometer* has been often held up as affording sure indications of an approach to ice, by the reduction of temperature shown both in the air and water, and these indications are important, and should by no means be neglected. But there may be many cases of approach to ice where a reliance upon the thermometer alone could not afford security.

On the ice chart, which is annexed, we have indicated numerous positions in which ice has been seen and reported on the common route of navigation, chiefly since 1832. This will serve to show the region where it is most often encountered.

Although little or no ice be seen in one passage, or even in many times crossing the Atlantic, yet it has been frequently met in such quantities as seemed to indicate a vast, or indefinite extension of the ice-fields, towards the polar seas. And from the inexhaustibility of the sources of supply, and the permanent character of the polar currents, we may infer that there is no spot of ocean within the influence of these currents which has not, at some time, been covered with ice.

A recital of the various authorities and marine reports from which our ice-chart has been compiled, might prove more tedious than useful. The following, however, selected from many others, may serve as examples of the cases in which the ice has been noticed by navigators.

Ship Eli Whitney, Harding, April 7, 1836, sea account: Wind S. S. W. and thick fog; ordered the temperature of the water to be tried every half hour; at 6 p. m. water 36°; passed a small ice island; ship going west all night three knots; 6 a. m. water 34°; at 8 a. m. water 31½°, passed considerable quantities of ice. At 10 a. m. saw a large field of ice ahead, which extended to the north and south as far as the eye could reach; entered it in expectation of finding an opening to westward. After proceeding a cable's length, wore round and stood out as we went in, and then hauled the ship on the wind to the S. E. Longitude by account, 47° 06′ W., latitude by account, 44° 41′ N.—April 8, wind S. S. W., stood to the S. E. till 5 a. m.; water 46°; tacked ship to the westward. At noon, water 44°, lat. by observation, 44° 35′, longitude by chronometer, 46° 56′.—April 9, wind S. S. W. and foggy. At 4 p. m. water 34°; wore ship to the S. E. At midnight water 44°; tacked ship to the westward. At 8 a. m. wind shifted N. W. and cleared off the fog; three large islands of ice in sight; water 44°; latitude by observation 44° 17′ N., longitude by chronometer, 47° 50′ W.—April 10, wind N. W.; passed six large islands; water in vicinity of the ice 40°, latitude by observation, 43° 09′, longitude by chronometer, 48° 55′.—April 11, passed four large islands of ice this day; at 8 a. m. sounded and found bottom with 42 fathoms; water 35°: latitude at noon by observation, 43°; longitude by chronometer, 50° 36′ W.

Ship Samuel Wright, Allen, March 18, 183–. Latitude 43°, longitude 48° 43′. At 3 p. m. very foggy, came nearly in contact with a very large island of ice, about 150

feet high and one mile in length: the weather extremely cold, kept the ship under easy sail. At 5 p. m. fell in with an English brig, and were informed we were standing for more ice, and that she had been for five days surrounded with it, extending from latitude 45° to 43°, and found no opening to the westward. Kept company during the night, and fell in with more ice; in the morning no ice in sight.

Ship Fama, Winsor, March, 183–, in latitude 44° 30′, longitude 48°, fell in with an immense field of ice; tacked ship to the eastward and stood off and on two days. Wind changed to N. E. and run 45 miles S. W. and passed the point of ice in lat. 43° 25′, long. 48° 50′.

The British Tar, Hanby, left the Gulf of St. Lawrence 29th June, and passed through the Straits of Belle Isle. On the 3d of July, about 15 miles eastward of Belle Isle, found the passage quite blocked up with very heavy fields of ice, which obliged us to put back to an anchorage. On the 6th again made the ice, and found it more open: passed through about 70 miles of it. On the eastern edge, fell in with nine brigs, a ship and a barque, standing off and on, waiting for a passage into the Straits. The icebergs were very numerous and immensely large, as far to the eastward as longitude 48°

Ship Oneida, Funk, May 4th, 1841, latitude 43° 40′, longitude 50°, passed a number of large icebergs; saw ice as far west as longitude 53°.

The brig Anne, of Poole, William Dayment, master, sailed from Greenspond, Newfoundland, [N. E. coast,] 19th January, 1821, and in the evening encountered several floating islands of ice. On the following morning, at sunrise, the ship was so completely enveloped in ice that there appeared no means of escape, even from the tops of the masts. The ice, in its whole extent, rose about fourteen feet above the surface of the water; it drifted towards the south-east, and bore the ship along with it twenty-nine successive days. On the 17th February, Capt. D. being three hundred miles east of Cape Race,* in lat. 44° 37′ north, perceived an opening to the southeast, and succeeded in disengaging himself. From the 29th of January to the 3d of February, the brig only made four miles a day: and during the 29 days this navigation lasted, he descried near one hundred very extensive mountains of compact ice.

Ship Isabella, Meredith, struck an iceberg on the 9th of May, 1841, in latitude 42° 2′, longitude 43° 45′. The iceberg broke through the bows, and caused the ship to fill with water so fast that the crew had barely time to take to the boats, without water, provisions or clothing: the ship immediately went down, or disappeared in the fog. The crew continued in the boat until the afternoon of the 11th, when they were picked up by the Kingston, of Hull, bound to Pictou.

Ship Lowell, on the 10th of March, 1842, at 9 a. m., latitude 44° 15′, longitude 48° 30′, came in contact with a field of ice; was at that time steering W. N. W., with the wind. Tacked and stood to the eastward two hours, when she again tacked to the westward. At 2 a. m. again fell in with the ice. Continued beating to the southward and falling in with the ice on the west tack till March 13th. Passed the southern extremity of the field in latitude 42°, longitude 49° 15′, having seen it extending in a N. N. E. and S. S. W. direction, nearly 150 miles.

A letter from Capt. Hosken, of the steamship Great Western, says: "April 18th, 1841, the ship steering west, at 6 p. m. first saw one iceberg on the starboard bow, at 7 30 passed it; at that time four or five others in sight; at 9 15 p. m. passed several small pieces of ice—slowed the engines. In a few minutes after the ship was surrounded with light field ice, which appeared similar to a field I ran through on the 11th of February, 1839. This induced me to go slowly, with the hope of getting through, as I had done on that occasion; but by 9 30, finding it closely packed, and much thicker, prudence dictated our escape by the same channel we had entered. I then stopped and attempted to get the ship's head to the eastward, by turning ahead and astern until there was room for her to come round; in the course of this operation the ship had occasionally (at least) two streaks heal given by either wheel passing over large masses of ice. At 10 15, succeeded in getting the ship's head to the eastward, and by 11 p. m. entirely clear. From that time went slowly, passing several icebergs; the night at times very clear, the aurora borealis very bright. At 3 30 a. m. of the 19th, again got embayed in the ice; stopped, hauled short round on our keel, and steered out E. by S., coasting the ice for five or six miles. At 4 20 kept her to the westward, running through innumerable icebergs until 8 30, when we passed the last iceberg and field of ice."

"When the sun arose the ice was visible as far as the eye could reach, in an unbroken line from N. E. by E., by the northward to N. W. by W.; at the same time, icebergs innumerable in every direction, forming one of the most magnificent sights I ever beheld."

* That this position was ascertained by chronometer appears doubtful.

The first iceberg we saw was in latitude 43°, long 48° 30′; and the last in latitude 42° 20′, longitude 50°. I am quite sure there was an unbroken field of that extent; and from what I heard from Capt. Bailey, of the packet ship South America, I have no doubt the field ice extended, with very little break, to latitude 40° 30′, where Capt. B. fell in with it on the morning of the 18th. Several other ships also fell in with it in the same longitude, and were completely stopped, giving them an opportunity of killing seals, which were on it in great numbers. Some of the icebergs I estimate at little, if at all less than a mile long, and from one hundred and fifty to two hundred feet high. This field of ice was in large masses, some of them not less than twenty feet square by six feet thick or more."

"The temperature of the water, when within two miles of the first iceberg seen, fell suddenly from 50° to 36°: air 40° to 36°. When in the ice, the water was 25°, air 28°; during the remainder of the night and following morning the water was not higher than 30° nor the air higher than 32°. Immediately after passing the last ice the water became 36° and the air 42°."

Brig Cynosure, on the 23d, 24th, and 25th July, 1842, latitude 42°, longitude 49° 30′, saw large icebergs, and was two days among the ice. Saw an island of ice that was estimated to be two hundred feet above the water, and saw several other islands in longitude 54°.

Ship England, Bartlett, April, 1842, latitude 41° 29′, longitude 49°, saw a large number of icebergs.

Brig Byron, Pierson, April, 1842, latitude 41° 18′, longitude 50°, saw four large islands of ice, one about 200 feet high and three miles long. Saw it thirty miles off.

British brig Peace, Robson, May 9th, 1844, made the ice in latitude 46° 52′, longitude 46° 30′, being bound to the Gulf of St. Lawrence, and was soon so completely imbedded in a large field of fragment that escape was impossible. She remained fast until the 13th, without injury, when in the night a gale of wind set in, crowding the large cakes down fast upon the sides and bulwarks of the vessel, which, from being in ballast, was soon stove in by the immense weight. On the 14th the small boats were got out and stocked with provisions, &c., and in the night of the same day the brig was abandoned. Capt. R. with crew and boats, remained upon the ice until the 18th, being unable to get into clear water, and on that day were taken off, in latitude 46° 50′, longitude 45° 42′, by the ship Copernicus, after much suffering.

Ship Burgundy, Wotton, in May, 1844, from the latitude 45° 30′ longitude 45°, to latitude 43° 30′ longitude 48°, was completely surrounded by icebergs and drift ice, lay to four nights, owing to the density of the fog; saw an iceberg two miles in length; no ice seen on the Banks.

Ship Virginia, Allen, latter part of January, 1844, was 34 hours fast in the ice. On the Banks, in a hurricane, lost foresail and main-topsail—saw large quantities of ice.

Ship Swanton, Heath, from 18th to 21st July, 1842, experienced thick, foggy weather, latitude 43° and longitude 49° to 54°, passed upwards of 300 icebergs, some of them very large; came near being wrecked on them, having run between two large islands in the night, which nearly rubbed the ship on each side before we discovered them, notwithstanding all hands were upon the lookout.

Captain William Wier, bound eastward, gave the following account. On the 9th of March, 1787, latitude 42° N., longitude 55° 40′ W., was called by the mate to see a large ridge of breakers: altered my course from E. S. E. to S., the appearance of breakers being N. N. E., and trending from E. N. E. to W. S. W. March 11th, latitude 43° 34′, found myself in the midst of a large body of ice, trending E. N. E. and W. S. W.; soon got through. March 13th, latitude 44° 03′, at 8 a. m., made a large body of ice, extending beyond view from mast-head, and trending N. E. by E. and S. W. by W. At 10 p. m., met a larger body of ice, which entirely stopped the ship's way. On the morning of the 14th, found myself enclosed, and could see no water from mast-head, except one small hole, into which I pressed the ship; in 23 fathoms water on the Grand Rank. In this dismal situation lay with my sails hauled up, till 21st March, seeing no sea from main top-gallant-mast head. On the 17th went on the ice to take a view of an island of ice which bore from us W. S. W. We set out at 12 o'clock, and travelled one hour and thirty-five minutes before we reached it. We found it aground in 25 fathoms, the main body passing fast by it, setting S. E. two and a half miles an hour, as I judged. On our return, having been absent three hours, the ice island bore W. N. W., having altered four points.

On the first day of January, 1844, Captain Burroughs, in the ship Sully, met with an iceberg in the Atlantic, in latitude 45°, longitude 48°. This is earlier in the winter than any other case which we have met with. Capt. B. states that he had met with ice near this position on the first of February, on a former voyage.

In September, 1822, Captain Couthouy saw an iceberg aground on the eastern edge

of the Grand Bank, in latitude 43° 18′, longitude 48° 30′. Sounding three miles inside of it, the depth was found to be 105 fathoms. In the month of August, 1827, the same observer, while crossing the Banks in latitude 46° 30′, longitude 48° W., passed within less than a mile of a large iceberg which was stranded in between 80 and 90 fathoms water. He was so near as to perceive, distinctly, large fragments of rock and quantities of earthy matter imbedded in the side of the iceberg, and to see from the fore yards, that the water for at least a quarter of a mile round it was full of mud, stirred up from the bottom by the violent rolling and crushing of the mass.

On the 27th April, 1829, Captain Couthouy passed, in latitude 36° 10′ N., longitude 39° W., [probably south of the Gulf Stream,] an iceberg, estimated to be a quarter of a mile long, and from 80 to 100 feet high. It was much wasted in its upper portion, which was worn and broken into the most fanciful shapes. In 1831, at daylight, on the 17th August, latitude 36° 20′ N., longitude 67° 45′ W., upon the southern edge of the Gulf Stream, he fell in with several small icebergs, in such proximity to each other as to leave little doubt of their being fragments of a large one, which, weakened by the high temperature of the surrounding water, had fallen asunder during a strong gale which had prevailed from the southeast.*

Ship St. James, Meyer, July 12, 1844, latitude 44°, longitude 47° 12′, passed 12 large icebergs; July 20, passed 25 do.; and July 21, passed 30 do.; latitude 43° 50′, longitude 52° 26′, saw the last of it.

John L. Hays, Esq., of the Boston Journal of Natural History, states that Capt. Crocker, of New Bedford, measured with his sextant an iceberg which was aground on the Banks of Newfoundland, and found it to be half a mile long and two hundred and forty-four feet high. Also, that Capt. Matthew Luce, of New Bedford, saw an ice island of one hundred feet in height, aground in forty-fathoms, on the Bank, and that the fishing vessels had sailed around it for 30 days.

Ship Switzerland, Knight, May 5th, 1844, in latitude 47° N., longitude 46° W., at 5 a. m. met with a perfectly solid field of ice, and the wind being N. E. hauled out to S. E. After coasting the ice 40 miles, found it turned to E., and that the ship was embayed. Tacked to N., and after four tacks of one hour each, the wind hauled to S. W.; steered east a short distance from the ice. Afterwards turned to the south, and the wind hauling to the westward, steered S. S. W. for forty miles more, when the ice became broken, and very soon was entirely clear of it, having sailed eighty miles along an unbroken coast of ice, exactly in appearance like low land covered with snow. The wind continuing to the westward, saw more or less ice for three following days, but none south of latitude 44° 43′, nor west of longitude 49°.

Ship Formosa, Crawford, June 18th, 1842, latitude 38° 40′, longitude 47° 20′, saw an iceberg 100 feet high and 170 feet long.

On the passage out in the Acadia, on the 16th of May, in lat. 46°, long. 47°, there were seen about 100 icebergs, some of them of large size, and one from 400 to 500 feet high, bearing so strong a resemblance to St. Paul's, that it was at once christened after that celebrated cathedral. The dome was perfect, and it required no extraordinary stretch of imagination to supply the turrets, pinnacles, and other parts of the building. On the homeward passage of the Acadia, on the 6th of June, the same object was seen, and the immediate exclamation on board was, "There's our old friend St. Paul's." In the interim between the two views, the iceberg had drifted about seventy miles."†

An immense ice-island was seen on the 10th of July, 1841, in latitude 43° 54′, longitude 58° 12′, by Capt. Ricker, of the Apollo, at Boston. He reports that his thermometer fell when near it forty degrees.

It may be proper to state here, that many ice observations have been placed on the chart without a reference to the date or the vessel which reported them, and the want of room for the references has rendered this in a degree unavoidable. In compiling the chart, one hundred and fifty-seven separate reports have been consulted, the general character of which may be estimated by the foregoing examples. Many other accounts might have been obtained, but it is believed that these are sufficient for an approximate estimate of the course and position of the ice in various seasons, so far as relates to the routes of vessels coming from European ports.‡

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* See Silliman's Journal, Vol. XLIII, 1842. † English paper.

‡ Much ice has been met during the present year, (1845) but in no unusual positions. It is hoped that ship-masters will report the exact positions of the ice when seen, particularly if the position is far south or west, or is otherwise remarkable.

On the Westerly tendencies of the Polar Ice-currents, and their Influence on the Gulf Stream.

In further noticing the westerly and southerly progress of the cold currents from the arctic regions, we avail ourselves of the researches of Rennell, who stated that "a current from Greenland and the Arctic sea joins the Gulf stream on the east of the Grand Bank of Newfoundland, somewhere about latitude 44°, and between the meridians of 44° and 47°. In the month of May its direction has been found to be between S. W. by S. and S., and its temperature [apart from the ice] 43° to 47° of Fahrenheit. The temperature taken not far to the eastward of it was 62° to 63°, and an easterly current of 30 miles [per day] of the same water (i. e. gulf water,) was found at a distance from the eastern edge of the S. W. by S. cold stream. This is doubtless the current that brings down the ice from Greenland, &c., to the east bank of Newfoundland, and ice has been seen in the line of this very current, by different persons in different years. The navigators to Newfoundland and New England, place the junction of these currents in about latitude 41°, longitude 49°, which shows how erroneous their ideas are on this subject."

Rennell likewise states that "there is also a smaller[?] current that passes down the coast of Labrador, and eastern side of Newfoundland, and carries ice in sight of the coast." He also says, that "it appears both from *his own* and other people's observation, that two distinct streams of ice exist; one on the east of the Bank, the other ranging along the coast of Labrador and Newfoundland; and then obliquely across the bank in a S. by E. direction; whilst that from Greenland, &c., runs between S. by W. and S. S. W. This last current appears to fall into the Gulf stream about the latitude 43° or 44°; and between the meridians of 45° and 50° W. The ice is, of course, carried into the Gulf stream, where from the warmth of its temperature, it must rapidly dissolve."* Rennell also states that many ice islands are found to the westward of the above, "in the line of the route from Halifax," and that "they are often seen in the Strait of Belle Isle." We quote also the following:

"An experienced commander, long in the Newfoundland trade, has said that the branch current which appears to come from Hudson's Bay, always sets to the southwestward (perhaps S. S. W.,) off the eastern coast of Newfoundland: sometimes at the rate of two miles an hour; its strength, however, varying with the direction and force of the wind. Passing down the eastern coast of Newfoundland, it turns about Cape Race, and sets thence along the south side of the island, until it meets with the current from the St. Lawrence, [through the Strait of Belle Isle,] a little to the westward of St. Pierre and Miquelon Islands.

"When the Virgin Rocks, lying about 80 miles W. by S., from Cape Race, were surveyed in July, 1829, the current set over them to the W. S. W. at the rate of one mile an hour.

"It is probable that this westerly current impinges on the easterly one, and continues its course with diminishing velocity, towards Breton Island, where it blends with that branch of the St. Lawrence stream which sets to the S. W. between Sable Island and Nova Scotia.

"The sea between the Grand Bank of Newfoundland and the Banks of Nova Scotia is distinguished by its drifts of *cold* water, varying with the wind and seasons."†

In further proof of the westwardly pressure of the polar current upon the American coast, we may state, on the authority of Captain Bayfield, the able officer who surveyed the Gulf and River of St. Lawrence, that "in spring the entrance and eastern parts of the Gulf are frequently covered with ice, and vessels are sometimes beset for many days;" and that "the reality of a current inwards through the Strait of Belle Isle, is confirmed by the presence of icebergs, which it transports into the Gulf in summer, against the prevailing S. W. winds, frequently carrying them as far as Mecatina, and sometimes even to the neighborhood of the east point of Anticosti." This last

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*I have not sufficient knowledge of that portion of the Greenland current which lies north of the Banks, to enable me to determine if its course from the coast of Greenland be directly towards the Flemish Cap and the eastern side of the Grand Bank, or whether it may not fall in with the Labrador current in longitude 48 to 51 off the Strait of Belle Isle, or the southern coast of Labrador, running from thence southeasterly parallel to the coast of Newfoundland and outside of the Labrador current, carrying with it the belt or stream of ice which it brings from the Greenland seas. It is hoped that this point may be satisfactorily determined, and in the meanwhile I have ventured to indicate on the ice-chart, hypothetically, the more direct route to the eastern ice region, as being that of the Greenland current.

The Labrador current must be viewed as a DEFLECTED CURRENT, till it has passed Newfoundland, being turned to a course which is east of S. by the lay of the land. W. C. R.

† Purdy, in Rennell.

position is nearly 300 miles from the entrance of the strait, and almost half way to Quebec.

But even stronger proof of this inward pressure of the cold current into the gulf and estuary of St. Lawrence is found in the icy temperature of its deeper waters during the summer. Thus, in the middle of the estuary, off Matan, and more than 200 miles above the east point of Anticosti, on the 8th of July, Dr. Kelly found the temperature of the surface water 60°,—at 30 fathoms 35°,—at 50 fathoms 34°; the whole depth at that point being 132 fathoms. A subsequent trial in this portion of the river showed the surface water at 57°,—at half a fathom depth 44°,—5 fathoms 40°,—10 fathoms 38,—100 fathoms 35°. At Tadousac, about half way to Quebec from the place of the last observation, Dr. Kelly found the temperature, in September, as low as 36°, after an easterly gale, which mingles the shallow stream of the surface with the deeper waters. Numerous other observations, made at different times and places, during the survey, confirmed these results. Hence it appears that the drainage waters received by the rivers were discharged by means of the surface current, which swept over the cold subjacent waters that were brought in by the polar current and the flood tide. These facts should be remembered in viewing the relations of the polar currents to the Gulf stream.

In relation to the southern outlet of the Gulf of St. Lawrence, it has been common for navigators and others greatly to overrate the proper *river* current of the St. Lawrence, in its extension southward of Breton Island and Nova Scotia. This fresh-water current, when compared with the branch of the polar current which joins it through the Strait of Belle Isle, is but of insignificant volume; and the current through this strait, in its turn, is but an ocean rill, when compared with the great volume and force of the cold currents which pass to the eastward and southward of Newfoundland.

It appears that Rennell was embarrassed in his investigation of the polar currents of this region, by admitting the assumption that a portion of the cold water, eastward of Newfoundland, was caused by the Bank itself. This hypothesis had been sanctioned by distinguished writers, but the observations and facts on which it was founded can now be satisfactorily explained by the admitted influence of cold currents, either superficial or sub-aqueous. He appears, also, to have viewed the Gulf stream as opposing a direct obstacle to the further passage of the polar currents, but it appears to us, that the streams of existing aqueous currents are found intersecting each other, much in the same manner as they would pass through quiet waters, and that they quietly impose or imbed upon each other like as stratified currents of air, or lateral currents from the forks of rivers, are found to accommodate each other, in their respective courses. In these river cases, as apart from the extraneous deflection by the shores, while the original momentum of each stream continues, one of these may be borne away from its original course, and thus be resolved to a new or modified direction by the further progress of the current in which it is imbedded; but in such cases, a diversion of the course of the lower current does not usually take place.

In the case of ocean ice-currents which intersect a surface cross-current, while the common *surface ice* conforms more or less nearly to the new direction of the current on which it floats, the deeply immersed ice masses, having probably their greatest bulk immersed in the lower or deeper current, are thus resolved by a real conflict of impelling forces, into a still different course, which conforms more or less nearly to that of the lower or subaqueous stream, according to the respective areas exposed to the action of the two currents, and their respective velocities. The geographical course of the body of the Gulf stream, according to our best information, commonly touches the southern point of the Grand Bank in latitude 43° N., but the overflow or out-spreading portion of the stream often sweeps over the southern part of the Bank, as a surface current, when unimpeded by the ice. When the ice appears in great quantities, it is probable that the Gulf stream current coming from the west, carries the ice more eastwardly, from its previous southwesterly course. In thus yielding to the joint influence of the two currents, the surface ice assumes a new direction, towards the south or southeast.

Grounded icebergs, when quite stationary, afford the best means for observing the course of the common ice-fields. The course of the ice-drift, within the influence of the Gulf stream, doubtless varies at different times and localities, and must be greatly influenced by the depth of the floating masses. For in the case of icebergs or islands, particularly those which come down from the Greenland seas and pass eastward of the Grand Bank, their great depth subjects them to the continued impulsion of the [illegible] or arctic current after they arrive within the influence of the Gulf Stream, the [illegible] part of the cold current passing beneath the warmer one, by means of its deeper position as well as greater specific gravity.

This may be shown from the cases before recited, of immense icebergs which have been impelled into the body of the Gulf stream, where, instead of being drifted off to

the eastward, in conformity with its course and with the like tendency of the prevailing winds, some of these floating islands have been forced across the body of the stream, and in some cases even far beyond its ordinary limits, to a latitude lower than that of the southern boundary of Virginia; as shown in the two cases given by Capt Couthouy. The most eastward of these, in longitude 39°, and south from the usual eastern limits of the Greenland icebergs that arrive in the latitude of the Banks, was near seven degrees lower in latitude than the southern extremity of the Grand Bank. The other icebergs noticed by him, in like latitude, and longitude 67° 35′, probably passed near to Newfoundland, and their position shows, in a more striking manner, the strong westwardly tendency of the polar current.

No impulsion but that of a vast current, setting in a general southwesterly direction and passing beneath the Gulf stream, could have carried these immense bodies to their observed positions, on routes which cross the Gulf current in a region where its average breadth has been found to be about two hundred and fifty miles.

The continued southwestern, and even more westwardly course of that portion of the polar current which is found southward of Newfoundland and Nova Scotia and west of the Gulf stream, is conclusively shown by the two icebergs met with by H. M. packet Express, July 7, 1836, on the southern edge of the Sable Bank, about seventy-five miles southwest from the Sable Island. The highest of these, estimated at 180 feet, was in latitude 43° 14′, longitude 61° 17′, the other, 150 feet high, in latitude 43° 09′, longitude 61° 26′. Owing to the great depth of these ice islands, they could not have passed through the Strait of Belle Isle, but must have been carried by the main current eastward and southward of Newfoundland to their observed position, which, by the nearest course, is near 500 English miles from off Cape Race, the southeast point of that island, in the direction S. 63° W., true meridian, or W. S. W. ½ S. Of the further extension of this portion of the polar current, in diminished force, along the coast of the United States and the western border of the Gulf stream, as far as Cape Hatteras, if not to Florida, we have formerly spoken, in another place.*

The finding of a low temperature on the southern part of the Grand Bank, or even to the southward of latitude 43°, is not sufficient evidence of the entire absence of the Gulf stream current, for the recent presence or proximity of floating ice must necessarily cause a great reduction in the surface temperature, and there is no natural process by which the cold water of the surface stream can be changed for warmer with a rapidity sufficient to preserve a temperature at all corresponding to the warm portions of the Gulf stream.

It is well known that vessels in the northern part of the Gulf stream, while steering parallel to its general course, have met with successive and striking changes in the temperature of the water, and sometimes with ice, to the southward of Nova Scotia and Newfoundland, and in the proper line of the polar current. This is well shown in the journals of the ships Eliza and Grand Turk, as published in some former editions of the Coast Pilot. In latitude 41° 53′, longitude 56 52′, the Eliza found the water at the depth of 70 fathoms two degrees warmer than that at the surface, the temperature of the latter being 40°, and an ice island bearing S. S. E., distant seven miles. S. S. W. and S. of the Grand Bank, and in nearly the above latitude, the Eliza again met with cold water, and passed several ice islands. Rennell has also recognized these cold veins or bodies of water in the Gulf stream. It appears, therefore, that in this portion of the Gulf stream, neither its presence nor its actual limits can be determined with certainty by the thermometer, during the ice season.

It appears in the pages of the Coast Pilot, that Captain Billings, in June, 1791, found the temperature of the water in the Gulf stream to have fallen 10 degrees, in latitude 39°, southward of the Bank, and that the like had been observed by Dr. Franklin and Col. Williams, in the same region. But judging from the latitude, it is not improbable that these observations were made to the *southward* of the true border of the Gulf stream. If this be the true solution, it is indicative of the partial re-appearance of the polar current, after passing beneath the Gulf stream; and there is evidence of its further course to the southwest and W. S. W., near the border of the stream.

This leads us to notice a probable, if not principal cause of the great variations, which have been reported, in the position and limits of the Gulf stream, in its eastward progress. Rennell, we conceive, rightly supposes an *overflow* or outspreading of the Gulf stream upon the ocean waters, as it proceeds in its course. Now we know, from well established cases, that overflowing streams, upon denser waters, are often very shallow; and Captain Bayfield has shown, in the case of the estuary and Gulf of St. Lawrence, that the effect of a storm is to break up for the time, this superficial

* Silliman's Journal, Vol. xxxii. page 349.

current, and amalgamate it with the deeper and colder waters. Hence we may infer, that in good weather and a smooth sea, the thermometric breadth of the Gulf Stream may be far greater than in rough weather; and that it is most straitened in its limits immediately after the occurrence of a great storm.

Perhaps too little consideration has hitherto been given to the character and effects of the polar currents. These appear to be well worthy of the attention of both the navigator and the philosopher. We have seen that the moderate but unceasing flow of these currents often interposes an icy barrier in one of the most common routes of navigation. The observing geologist will also discern in the course of the great ice-currents of the Atlantic, both before and after their contact with the tropical stream, a striking coincidence with the directions of the two systems of striæ which mark the abraded surface of the continental rocks, the origin of which must be referred to the early and prolonged period when these rocks were situated beneath the ceaseless flow of the ocean currents.*

New York, September, 1845.

Note.—The year 1851 was remarkable for the quantity of ice that was seen, and its early appearance. It was seen early in January, on the N. E. edge of the Banks of Newfoundland, and in April it was seen from latitude 48° N., longitude 43° W., to latitude 43° N., longitude 56° W.

The writer of this note, on board the steamer Humboldt, Capt. Lines, on 11th May, 1851, saw the ice in lat. 46°, long. 49°, and passed more than 50 icebergs, from 15 to 150 feet high, leaving it in lat. 46° 30′ long. 47°. The ice had an E. N. E. and W. S. W. direction.

On the return passage, June 14, the same steamer fell in with the ice in latitude 46° 36′, longitude 49°; two icebergs only.

The year 1854 was also remarkable for the early appearance and great extent of the ice. It was seen in February, by Capt. Delano, ship Albert Gallatin, in lat. 58° long. 43°, and from that time to the present it was fallen in with as far south as lat. 42° 46′, and long. 52°.

June 18, immense quantities were seen from the steamer Union, in lat. 43° 54′, long. 48° 20′.

July 1, 1854. G. W. B.

Nov. 7, 1854, ice was seen from steamer Atlantic, in lat. 48°, long. 48° 25′.

Feb. 15, 1855, ice was seen from steamer St. Louis, in lat. 44° 58′, long. 55° 31′.

March 27, 1855, ice was seen from steamer Union, in lat. 45° 36′, long. 59° 20′.

REMARKS AS TO THE DEPENDENCE ON THE THERMOMETER AS A MEANS OF DETECTING THE VICINITY OF ICE.

BY THE REV. W. SCORESBY, D. D., F. R. S.

With Mr. Towson's view as to the security against falling in with ice to be derived from watchful attention to the temperature of the sea, and as to the thermometer being capable of insuring safety by giving indications of approach toward ice, my personal experience and consideration of the question have not brought me to agree. Not that in the vicinity of large bodies of packed ice, or of numerous icebergs near together, the temperature of both the air and the sea, in certain relations to the direction or drift of the ice, may not be sensibly affected, and sometimes to considerable distances; nor that the unusual lowness of the temperature of the sea-water will not indicate a descending polar current, and therefore a greater probability of ice being met with (as indeed our present and recent experience characteristically showed); but that the rule of alteration in the sea temperature, or in that of the air, can apply with any sort of certainty to the determination of approach to ice, much less to detached masses, is, I am satisfied, a mistake. The practice of noting the temperature of the sea is an excellent one, and *may* happen, as in cases cited by Mr. Towson, to be admonitory, but, if relied on, it would be found deceptive. The chilling or radiating influence of an isolated iceberg cannot sensibly affect the temperature of the air to windward of it, or on the sides, to any considerable distance; nor could the sea be altered in its general temperature for miles around, except in the track, perhaps, of its drifting.

The attention to the thermometer recommended is good, and may be useful; but the only effective safeguards, under Providence, will, I believe, be found to be these two: First, a perpetual and strict attention to the look-out day and night, by men made aware of the signs of ice and the danger of encountering it, within the possible ice limits; the look-out to extend to a watch for fragments of bergs, which may be discerned

* Silliman's Journal, Vol. xliii., page 152—Vol. xlv., page 326.

by the roll of the sea over them, as if breaking on a small sunken rock; and, secondly, in giving such attention to the adjustment and quantity of sail during the night or thick weather, when ice has been seen or may be reasonably expected, as may allow for hauling up or bearing away in the event of sudden necessity. To these may be added the suggestions given under date of April 1, with the importance of a look-out aloft in critical cases.

"*April* 1.—A fair estimate of our danger from the icebergs could not be easily made. In a gale so heavy, with the occurrence of ice in uncertain and undeterminable quantity and distribution, no considerate person could be free from solemn thought or apprehension. But the regulation of these feelings under such circumstances is a matter of much importance to personal comfort, and with the Christian man matter for peculiar submission to and repose on the Divine providential will and guidance. Rationally considered, the special dangers on the one side are meeting with a succession of icebergs after shifting the course or partially hauling to, so as to render the *weathering* of a second or third iceberg, or the getting of a large ship of the clipper class sufficiently off the wind in time to wear clear of the danger, impracticable—besides the possibility of another of these formidable enemies to security appearing in the line selected for escape. Over and above this must be noted the special and even more formidable danger of falling in with detached fragments of ice; lumps from fractured and wasting bergs lying low in the water, and without the provision of luminosity for making themselves visible, yet in masses sufficiently great to stave in the bows or utterly destroy the strongest existing ship. Such dangers encountered in darkness, aggravated by showers, or haze, or fog, are not to be rationally contemplated without some serious or anxious thought.

"But on the other hand, the question of danger ought to embrace the probable extent, number, magnitude, and frequency of icebergs on any given track, in comparison with the magnitude or width of the spaces among them. To the proportion in favor of safety must be added the effects of watchfulness on the part of the navigator, forming some previous estimate of his position of danger; the chances of the icebergs being passed in daylight, moonlight, or in moderate weather, or revealed when in the way by their luminosity; and, finally, the results of experience in the comparative fewness of the accidents demonstrated by the small additional premium, and the moderateness of the premium generally demanded by underwriters for the insurance of ships voyaging to Australia or New Zealand. So estimated, the result comes out there is risk, and considerable risk, to ships voyaging through seas liable to the danger of icebergs; yet the risk, taken on an average, and in a merely intellectual or commercial point of view, is but small. In our particular case, the risk from separated fragments of the bergs we passed was lessened by the course we pursued and the steady direction of the gale; as fragments in a gale and heavy sea will always be found nearly a-stream of the iceberg—that is, in the line of the wind from the berg—to windward or to leeward; but we, in keeping far on one side, did not intersect or come near this unusual line of icy debris and fragments. Hence, as a cautionary rule for sailing among icebergs at night, I would recommend the passing of them, if possible, well on one side, in respect to the direction of the wind, and not to intersect the stream-line of the ice."

Important, however, as the admonitory indications of the surface temperature are, the terms in which confidence in such indications are frequently expressed need limitation and modification. The existence of a descending current from the polar regions, as I have said, will generally be pointed out by a temperature in the surface water below that of the prevalent temperature; and still more characteristically by a sudden considerable reduction. The general inference within the ice region is *not* that ice *will* be seen, but *may* be seen; not that the actual approach toward an iceberg will be pointed out, but that an iceberg or icebergs may not improbably be near. The importance of observing the temperature of the sea, therefore, as a cautionary and admonitory sign of ice, can hardly be overrated. But it may not be trusted as either infallibly certain or as a sign always to be rightly interpreted. Sometimes the transition from the waters of temperate regions to those of polar currents is so sudden that the sailing only for a few minutes may take a ship from one to the other; while a mile or two of distance may change the temperature some degrees. In such cases, the ice brought down by the currents from the polar regions, especially *drift* or *packed* ice, which drifts rapidly in the direction of the wind, may be swept into the strange waters of another climate, where the surface temperature, except in the track over which the ice may have passed, can give no intimation of its proximity or existence.

NOTES ON THE GULF STREAM.

BY A. D. BACHE,

Superintendent of the U. S. Coast Survey.

(*Revised to* 1854, *and communicated by authority of the Treasury Department.*)

THE developments made by the Coast Survey in the summer of 1853, in relation to the Gulf Stream, requiring a revision of the notes to bring them up to date, I have at the request of Mr. Blunt, and by authority of the Treasury Department, embodied the new results with the former ones and communicated them for publication, that navigators may be benefited by the extensive circulation which they will receive in this form.

The Gulf Stream and the approaches to it have been explored in the progress of the survey of the Coast between the limits of a line perpendicularly across it from Cape Cod, to another from Cape Canaveral, the observations generally extending from about 42° N. Latitude to about 28½°, and from about 65½° W. Longitude to 80½°. The observations were made under detailed instructions from the Superintendent, by the following-named Officers of the Navy, Assistants in the Coast Survey:—

By Lieut. Com'g C. H. Davis, who examined in 1845 the Section from Cape Cod, and positions to the southward and westward of it; by Lieut. Com'g Geo. M. Bache, who in 1846 explored the Sections perpendicular to the Stream from Sandy Hook, from Cape May, and from Cape Charles; by Lieut. Com'g S. P. Lee, in 1847, who explored the Cape Charles Section; by Lieut. Com'g Richard Bache, in 1848, who repeated the observations on the Cape Charles Section, and explored the Hatteras Section; by Lieut. Com'g J. N. Maffit, in 1853, who went over the Hatteras observations, and examined the Sections from Cape Fear, and from Charleston; and by Lieut. Com'g T. A. Craven, during the same season, who explored the Charleston, St. Simon's, St. Augustine, and Cape Canaveral Sections, and several other positions towards Cape Florida.

The different sections of the Stream were designed to be perpendicular to its axis from prominent points of the Coast, at such distances from each other as would insure a thorough knowledge of its whole course. It was foreseen that the surface observations would be of comparatively little value, from the varied character of the circumstances to which the surface water is exposed, and the observations were accordingly carried to considerable depths. I propose to give the general distribution of the temperatures shown by the several sections, and to connect with this, remarks on other points developed by the examinations.

1st. The Ocean within the region of the Gulf Stream is divided into several bands of higher and lower temperature, of which the axis of the Gulf Stream is the hottest, the temperature falling rapidly in-shore, and more slowly outside. This is not only the case at the surface, but with modifications, easily understood, at considerable depths. It is represented in the annexed Diagram (No. 1), showing the distribution of temperature on the Sandy Hook Section at the depth of fifteen fathoms, from the observations of Lieut. Geo. M. Bache. The scale of nautical miles on top shows how far the several points are from Sandy Hook. The scale at the side shows what the thermometer, with Fahrenheit's scale, would read if let down fifteen fathom at the several positions marked at the top. The thermometer say at Position I, 100 miles from Sandy Hook, let down fifteen fathoms would mark 63°; at III, 150 miles would mark 67°; at 240 miles 63½°; and at 280 miles 80½°. When the curve rises, the thermometer would rise, and vice versa. Three points, b, d, and f, decidedly warmer than those on either side of them are seen; the warmest is at the axis of the main Gulf Stream. There are four points of low temperature, lower than those either inside or outside of them. The changes on the Cape May Section are even more strongly marked, the curve of fifteen fathoms being dotted on the same diagram, and including a fourth point of high temperature, h. The curve of one hundred and fifty fathoms on the Cape May Section is added, as showing how boldly these features come out at considerable depths.

The curve of twenty fathoms on the Charleston Section in the Diagram (No. 2), shows the same thing. The curves deduced from the mean of observations at two hundred and three hundred fathoms give a similar result. These cases are mere illustrations of the general fact.

These bands are also shown in the sketch A, where the dark shades correspond to the warm bands, and the light spaces to the cold ones.

2d. Among the cold bands is one so much colder than the rest as to be very remarkable; it is that next inside of the axis of the main stream, and the change of temperature between it and the stream is so abrupt that Lieut. G. M. Bache called the space the "cold wall," the cold water appearing to confine the hot water as by a wall on the in-shore side. The Sandy Hook Diagram (No. 1), shows it between 230 and 280 miles from the shore, the Cape May between 132 and 178 miles from the shore; the rise in the first curve is from $62\frac{1}{2}°$ to $80\frac{1}{2}°$, eighteen degrees in fifty miles; in the second from 62° to $83\frac{1}{2}°$, or $21\frac{1}{2}°$ in forty-six miles. At Charleston the rise in the twenty fathom curve is from $67\frac{1}{2}°$ to 79° in fifteen miles; at St. Simon's from 70° to 76°, in twelve miles. The rate is between four-tenths and eight-tenths of a degree to the mile.

Of the cold band inside of this I shall speak again. The two outside ones, though characterized by much smaller differences of temperature than between the axis and the cold wall band, are sufficiently marked, and should be known, because in crossing the stream after warm water is met with to find cold, then again warm, then cold, would baffle the navigator who was looking for no such alternations, and would greatly instruct him if he knew what to expect.

3d. The alternate cold and warm bands are represented on the chart A from a first discussion of the Coast Survey observations. Their positions may be somewhat changed by a more complete discussion. The line which crosses the Sandy Hook Section at A is the axis of the Gulf Stream, taking the general directions of the bends of the coast, rather of those below than above water, and thrown quite eastward by the shoals off the Southern Coast of New-England. We have not yet traced it further than is shown in the diagram, but of course propose to do so. We know, however, that one branch reaches the shores of Ireland, parting with its heat as it goes, but retaining enough to reproduce there, as Prof. Harvey, of Dublin, has remarked, the algæ of the Florida Coast. The shading upon the map is intended to represent the higher temperatures by the deeper shades.

The axis of the next warm band, which is well made out in the observations, crosses the Sandy Hook Section at C. It is not certain whether G, on the Charleston Section, connects with it or not: the more probable supposition is shown on the Chart, leaving to future observations to settle the point; the bands M and L are perfectly well defined from St. Augustine to Charleston. There was another pair of cold and warm bands noted on the Cape Henry Section, and shown on the diagram, between the hot water of the Gulf Stream, and the band which, north of this, is the first cold band outside.

There is an axis of warm water distinctly shown on the Cape May and Hatteras Sections, beyond the last ones inserted on the Chart, but its position is not well determined. Warm water was found on the Cape Henry and Hatteras Sections, as far E. and S. as shown on the diagram.

Inside of the Gulf Stream, marked by E, a band of warmer water than the surrounding ocean, shows itself before striking soundings to the north, but afterwards on the southern coast. This is well marked by the observations on all the Sections, though its position is not so well determined as the others.

The axis of the most marked cold band, the minimum of temperature which forms the "Cold Wall," follows the shore and shoals in its bendings, even more closely than the axis of the Gulf Stream. This is traced from our observations beyond the range of the other lines, with considerable probability, to longitude 66°.

The two axes of cold water outside are marked, where they cross the Sandy Hook Section, by the letters D and F. Beyond the last of these many of the Sections show a line of minimum temperature, on striking soundings, but its position is not well determined.

North of Hatteras, the Sections show another line of minimum temperature, on striking soundings of from one hundred and fifty to seventy-five fathoms.

4th. To understand this distribution of temperature, it must be remembered that the warm water of the Gulf Stream rests on a cold current from the north, flowing towards Cape Florida, the coldest water keeping near the Atlantic Coast, below the surface, if not at it. The following table will prove this, though it contains but a few of the very numerous observations.

TABLE,

SHOWING THE TEMPERATURE BELOW THE SURFACE AXIS OF THE GULF STREAM, AT FOUR HUNDRED FATHOMS, FROM SANDY HOOK TO CAPE FLORIDA. THE TEMPERATURE OF THE SURFACE CORRESPONDING TO THESE TEMPERATURES BELOW, EXCEEDED 80°.

				FAHR.°
Sandy Hook,	July,	1846,		51.
Cape May,	August,	"		51.
Cape Henry,	"	"		$54\frac{1}{2}$.
" "	"	1848,		$52\frac{1}{2}$.
Cape Hatteras,	July,	1853,		51.
Cape Fear,	June,	"		51.
Charleston,	June,	"		55.

			FAHR.°
St. Simon's,	June,	1853,	54.
St. Augustine,	"	"	51.
Cape Canaveral,	"	"	46½.
Fort Jupiter,	"	"	46.
Hillsboro' Inlet,	"	"	51.
Cape Florida,	"	"	51.

At 1000 fathoms off Cape Hatteras, the temperature was but 40

The warm water of the Gulf Stream is of very different depths at different points of its course, and in different parts of any one of the Sections across it. From the deepest portion in the cross-sections, the warmer water flows off towards the shore and outwards, overlaying the cold. The way in which it thins off is seen in the annexed Diagram (No. 3), from the Sandy Hook Section, where the curves of 80°, 75° and 70° of temperature are shown. All the water above the curve a b c d e, is above the temperature of 80°, so between it and curve f g h i k, is between 75° and 80°. This thins out as it approaches the shore; the cold water which lies on the bottom coming up in the northern Sections, but the warm water prevailing to the very shore, and at considerable depths, in the southern. When the cold water is forced up by a bank or shoal, or when it comes to the surface from the thinning out of the warm, there is of course a considerable change of temperature. This cold water from the north prevails on the inside of the cold axis at moderate depths, as far south as Hatteras. At thirty fathoms, twenty nautical miles from Hatteras Light, in August, 1853, the temperature was 60°, bottom being found at thirty-three fathoms. At twelve miles it was 74° at the surface, and in five and ten fathoms, the bottom being at eighteen fathoms. The highest temperature in that Section, and at that time, in the axis of the Gulf Stream, was 78°. One hundred and eight miles from Sandy Hook, in August, 1846, the temperature of the axis of the Gulf Stream being 84°, the surface temperature was 71¼°, at five fathoms, 67°, at ten fathoms, 66°, at fifteen fathoms, 65°, at twenty, 58°, and at thirty fathoms, 52½°, diminishing in the first fifteen fathoms 6¼°, and in the second 12½°. This is the cold counter-current which gives character as well as motion to the water near the shore north of Hatteras. We have seen that the cold wall is not cut off at Hatteras, and it is altogether probable, from the observations of Lieut. Com'g Maffit's party this year, that the counter-current still prevails south of Hatteras. Acting-Master Jones found it about fifty miles S. E. of Charleston Light, running to the S. W., or along the shore, the surface water being 75°, and that at twenty fathoms, 68°, and in the axis of the Gulf Stream, 82°. The distance from this point to the axis was about twenty-three miles, so that moderately warm water extends to the very bottom.

As it was found desirable, if not absolutely essential, to direct special attention to the solution of one problem at a time, our results for currents are not numerous, but they are sufficient to show a general tendency near the surface from the axis of the Gulf Stream outwards, besides the onward current.

The direction of the axis of the Stream shows, therefore, the set of the current in that band. To the right and left of it, the current is outward and onward, and to the left, as far as the cold wall, is inward and onward. Inside of the cold wall, north of Hatteras, and probably south of it, the current is to the southward, or along the coast. The rate of the current in the axis of the Stream, on the Cape Canaveral Section, is about three nautical miles per hour, on the Cape Fear Section about two miles, and on the Sandy Hook Section about one mile per hour.

5th. The observations of this year have fully proved that in the Charleston Section, and those south of it, the bands of cold and warm water are produced by the shape of the bottom of the sea. The Diagram (No. 4) shows this shape on the Charleston Section. The party of Lieut. Maffit carried soundings 68 miles from Charleston Light, and after losing them at 600 fathoms for 32 miles, sounded in three hundred fathoms, then in 550 fathoms, and so on to the limits of the Section, 210 miles. This gives a section of the bottom, as shown on the Diagram, sloping gradually to twenty fathoms, then more rapidly to one hundred fathoms, and falling off suddenly. The next sounding, thirty miles from the one hundred fathoms, was on an elevation sloping rapidly on the in-shore side, less steep on the off-shore, but rising three hundred fathoms above the bottom eleven miles southward and eastward, then another elevation, and then onward as if tracing some of the hills and valleys far inland. This ridge was discovered independently by Lieut. Craven, within two days and a half of Lieut. Maffit's first finding it on the Canaveral Section, struck again by him on the next two Sections, and again, just north of this, on the Charleston Section, without being aware of the previous discovery.

The curve of temperature of 57°, traced on this Diagram (No. 4), follows with great precision the shape of the bottom, which is the more remarkable that every observation involved in it is entirely independent of every other, and that the results of many positions and many depths at the same position are concerned in the tracing of that curve. The curve of 62° has but a single irregularity. These elevations force up the cold water into the warm, and cause the cold streaks and the division into warm and cold bands. There is

one narrow band on the Charleston Section which does not extend below a certain depth, and which shows that other causes may produce them, as indeed we know must be the case; but with two exceptions, the distribution of temperature of the water in this Section, and all south of it, are proved to be connected with the form of the bottom. Just on the crest of the steep slope in-shore, a cold band is formed by the forcing of the cold water upwards, and very remarkably, on part of the St. Simon's Section, which is drawn on the Diagram No. 5, to show the fact.

I remarked while noticing the bands on the Northern Section, that one of low temperature occurred first when soundings of about one hundred and fifty to seventy fathoms were struck. This is a similar case to the one we are now considering, as the sections on the Coast Survey Chart, from Cape May to Gay Head, made without any reference whatever to this subject, fully show. It is, in fact, only an extension of the principle of the forcing up of the cold water on shoals. If the strata of water were parallel to the bottom, the cold water would come nearer the surface, but it rises even higher than this as the current flows along these steep slopes.

Is the figure of the bottom the cause of the distribution of temperatures in the northern sections? It seems almost irresistible to generalize, but as the question is one which we can answer by observation, it is better to let speculation wait upon the facts.

6th. In regard to the permanence of these bands of temperature, and the possibility of determining their position with reasonable precision, it may be proper to make some remarks. The Cape Henry Section was run over three times, the Hatteras twice, the Charleston twice, for the very purpose of making such comparisons as would connect together the observations of different years. The comparisons thus made, show that the differences are of the same class as those which affect the position of the Gulf Stream, in different years, at different seasons, and under different circumstances, as wind and the like. The distances of the positions at which observations were taken, varied with the character of the changes, being less distant as the changes were greater. This will affect the degree of accuracy of the result. The southern Sections presented all the phenomena on so small a scale, comparatively, that there the positions succeeded each other at small intervals. The most marked changes would of course, even were the observations but equally numerous, be best determined.

Another mode of ascertaining how far the results may be depended on, is to determine the discrepancies which they show at the different depths. The whole of the results showed as a general rule, to which the exceptions were readily understood, that the points of highest and lowest temperature were sensibly in the same perpendicular line, except those of the axis of the "cold water" and of the Gulf Stream, which are forced by the action of the cold water further from the shore, according to a law which the observations make out. The discrepancies from the mean positions, agreed well with the determinations from the observations above referred to, and the liability to error computed numerically, was always considerably less than the half of the average distance between the positions. As far as I have as yet been able to examine the results, this is the general conclusion.

7th. The variations of temperature in different years and at different seasons, is considerable. In the observations made during the same season, the more southwardly Sections gave in general the highest temperatures. Not to complicate the examinations with surface irregularities, if we compare the maximum temperatures at twelve or fifteen fathoms below the surface of the different Sections in the same year, we shall find as a general rule, an increase of temperature in passing southward, as 81°, 83°, 82°, from the Sandy Hook to the Cape Henry Section in 1846, 75½°, 76°, 77½°, 79½°, from the Charleston Section to Cape Canaveral. But in the successive years we have found the highest temperatures at twelve fathoms, on the Cape Henry Section higher than that of Hatteras; and the temperatures in July, 1846, on the axis of the Gulf Stream, higher at Sandy Hook than in June, 1853, at Canaveral, by a degree and a half, and higher than at Charleston by five and a half degrees.

8th. The law of change of temperature with depth which has been developed, is that of the conduction of heat through a liquid. The low temperatures reached, showed that the Gulf Stream is comparatively a superficial current, and is underlaid by a vast ocean of cold water—so cold as not only to compensate for the increased warmth of the earth in descending, but to carry to the southern regions the temperature of the far north.

This underlaying water, where it "crops out" on shoals at the shore, shows a sudden decrease of temperature in the surface of the ocean.

9th. In exploring the Gulf Stream, it was crossed, as already stated, in sections, as nearly in right angles to its axis as practicable, continuing the section until the general ocean on the opposite side of the stream from the coast was reached.

The temperatures were observed from the surface to the depth nearly of 500 fathoms, varying, at first, by depths of ten fathoms, and afterwards, as the difference of temperature in descending became less considerable, by greater difference of depth. In a few cases the depth reached was 13 and 1500 fathoms—one mile and three-quarters nearly.

At great depths, the pressure to which the instruments are exposed is such as to re-

quire special ones for measuring the temperatures. Many trials were made of different kinds of instruments, but the most successful was Saxton's metallic thermometer, which has been described in the "Memoir on the Dangers and Ice of the North Atlantic," fourth edition, 1852, and which continues to be used in our work with satisfactory results.

Such a thermometer, with a scale showing every two degrees of Fahrenheit, would not be an expensive instrument; and as it takes the temperature of the sea very rapidly, and registers it almost infallibly, much time would be saved to the navigator by its use.

9th. The investigations from which the foregoing results were deduced having been made at considerable depths, it may be objected to them that they were not strictly confined to obtaining results desirable in practice.

A sufficient reply to this objection would be, that the laws sought to be ascertained were best displayed in the deep-sea temperatures; and that, unless the exploration embraced the whole of the scientific connections of the problem, it would be sure, in the end, to fail in the developments necessary for practice. Besides, why should not the navigator be provided with a suitable thermometer, and take temperatures at just such depths as are best suited to guide him as to his position? In the progress of the art of navigation, I have no doubt that observations of this kind will become common.

The surface of the Stream, changed in its motion and temperature by winds and rain, is not the portion where the laws which govern either are to be expected to display themselves with regularity.

The temperature observations at the surface, ten and fifteen fathoms, have been found irregular, especially the former. Below twenty fathoms to the considerable depths of about one hundred and twenty fathoms, when the change in the phenomena becomes marked, there is much more constancy in the results. The depth of twenty, and even thirty fathoms, can be explored by a common Six's self-registering thermometer, an inexpensive instrument, without appreciable error, and even by a common thermometer enveloped in cotton, or other bad conducting material, allowed to remain below the surface a sufficient time to take the temperature, and then drawn rapidly up and observed promptly.

The depth of twenty fathoms is recommended to navigators for their observations.

A common thermometer surrounded by a copper case, say three inches in diameter, stuffed near the bulb of the instrument with cotton, will answer a good purpose. Six's self-registering thermometer, which may be had at any of the instrument makers, will be still better.

The most prominent phenomena only are moderately permanent at the surface.

DEPTHS OF OBSERVATIONS FOR TEMPERATURE IN THE GULF STREAM.

(*In fathoms.*)

Section off Block Island, by Lieut. Chas. A. Davis, in 1846.		Section off Sandy Hook, by Lieut. Geo. M. Bache, in 1846.		Section off Cape May, by Lieut. Geo. M. Bache, in 1846.		Section off Cape Henry, by Lieut. Geo. M. Bache, in 1846.		Section off Cape Henry, by Lieut. S. P. Lee, in 1847.		Section off Cape Henry, by Lieut. Richard Bache, in 1848.		Section off Cape Hatteras, by Lieut. Richard Bache, in 1848.		Section off Cape Hatteras, by Lieut. J. N. Maffit, in 1853.		Section off Cape Fear, by Lieut. J. N. Maffit, in 1853.		Section off Charleston, by Lieut. J. N. Maffit, in 1853.		Section off Charleston, by Lieut. T. A. Craven, in 1853.		Section off St. Simon's Bay, by Lieut. T. A. Craven, in 1853.		Section off St. Augustine, by Lieut. T. A. Craven, in 1853.		Section off Cape Canaveral, by Lieut. T. A. Craven, in 1853.		Irregular Observations, by Lieut. T. A. Craven, in 1853.	
Position.	*Depth.*	*Position.*	*Depth.*	*Position.*	*Depth.*	*Position.*	*Depth.*	*Position.*	*Depth.*	*Position.*	*Depth.*	*Position.*	*Depth.*	*Position.*	*Depth.*	*Position.*	*Depth.*	*Position.*	*Depth.*	*Position.*	*Depth.*	*Position.*	*Depth.*	*Position.*	*Depth.*	*Position.*	*Depth.*	*Position.*	*Depth.*
.....	.....	I	170	I	33	X	20	XIII	47	I	18¼	XII	17	I	10	XI	73?	*a*	10	XXXIV	80	XXV	28	XV	19	VI	20	I	550
.....	.....	.....	.....	.....	.....	XI	50	.....	.....	II	24	XIII	60	II	12	X	70?	*b*	20	XXXV	215	XXVI	100	XVI	135	VII	30	II	500
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	XI	25	III	33	.....	.....	*d*	20	XXXVI	290	XXVII	180	XVII	300	VIII	150	.....	...
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	IV	75	.....	.....	*c*	30	XXXVII	480	XXX	500	XX	560	XII	400	IV	600
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	*e*	30	XXXIX	600	XXXII	520	XXI	450	XI	460	V	15
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	*f*	50	.....	.....	.....	.....	.....	.....	.....	.....	XIV	150
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	I	100	.....	.....	.....	.....	.....	.....	.....	.....	XXI[V]	20
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	IV	550	.....	.....	.....	.....	.....	.....	.....	.....	.....	..
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	V	300 to 400	.....	.....	.....	.....	.....	.....	.....	.....	.....	...
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	VI	450	.....	.....	.....	.....	.....	.....	.....	.....	.....	...
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.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	VIII	470	.....	.....	.....	.....	.....	.....	.....	.....	.....	...
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	IX	460	.....	.....	.....	.....	.....	.....	.....	.....	.....	...
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	X	400	.....	.....	.....	.....	.....	.....	.....	.....	.....	...

ADDITIONAL REMARKS.

In addition to the foregoing, the following general facts may be stated:—

1. That in the summer, the temperature of the Gulf water, south of Hatteras, is about the same as the water on soundings. In the months of July and August, 1845, the temperature of the water from the Mississippi to Cape Hatteras, both in and out of the stream, even to the very mouth of the Atlantic rivers, was 84° to 82°. This fact was ascertained by journals kept for the editor.

2. That the temperature of the Gulf, south of Hatteras to Savannah, in the winter months, is from 72° to 75°, and that on soundings, within the same limit, at the same time, 59° to 68°; and north of Hatteras, 48° to 64°, showing a difference of from 11 to 5 degrees higher temperature to the south of the cape.

3. The general direction of the Gulf Stream, from Key Biscayno until it gets to the lat. of 31° 10′, is north, velocity 3 to 3½ knots; from thence it turns to the N. N. E., and as it progresses to the north, it turns more to the N. E. On the western edge of the Stream the Gulf-weed is mixed with the river sedge; on the eastern edge it is clean as when first torn from the rocks. It appears from a notice in the Nautical Magazine, that some of the weed grows on the shores of the Andros Islands.

4. The western edge, from Key Biscayno to lat. 31° 10′ N., is generally on the meridian of 80°; the eastern edge, after passing the Little Bahama Bank, is about 79°, until in the latitude of 30° 30′, when it is turned more to the eastward. This, however, is in moderate weather. During heavy gales from the N. E. to the S. E., the stream is forced immediately on and over the shoals of the Capes of North Carolina; and with N. W. and westerly gales, the stream is driven from the shore, and no limit within thirty miles can be fixed to it; and under such circumstances the warm water of the Gulf is displaced, so that at times there will be no current in the warm water, and current in the cold water.

5. The edges, in moderate weather, are shown by the ripplings in the low latitudes, and in the high latitudes, during the winter, with northerly weather, by the evaporation from the surface.

6. The precise part where the stream begins to form is not known. It is shown before, under the general article of "Currents," that the current sets to the W. N. W. and N. W., over the Campeche Bank; and that at a short distance west of the Tortugas, the current sets to the S. S. E.; but where the proper head of the current is, is yet to be found.

7. On the western side of the Gulf Stream, from Sandy Hook to Hatteras, the current sets south, a little westerly, about 20 miles in 24 hours.

8. On the eastern side of the Gulf Stream, nearly down to Matanilla Reef, the current sets to the south and west, almost opposite to the flow of the Gulf, at an average of 20 miles in 24 hours: the New Orleans steamers take advantage of it by crossing the Gulf Stream near Hatteras, and from about 33° 30′ N. lat. 74° 30′ W. long., steering directly for Matanilla Reef.

Of the Stream to the eastward of the Coast Survey examination we want definite information. The following is the most accurate observation we have:—

Ship Trade Wind, on the 26th of June, at 11h. 30m. P. M., came in contact with the ship Olympus, and both vessels went down in lat. 41° 30′, long. 57°. On the 1st of July, 2h. 30m. P. M. the ship Empire took a sailor from the fore-mast of the Trade Wind, in lat. 42°, long. 55° 30′, showing that the mast had drifted 72 miles on a N. 66° E. true course, in 101 hours, making $\frac{72}{100}$ of a knot, nearly, an hour.

G. W. BLUNT.

May, 1854.

The following report of Lieut. Walsh, U. S. N., to Lieut. M. F. Maury, of the Observatory at Washington, communicating the results of an expedition planned by Lieut. Maury, is of great interest, as it enables us to expunge *on authority*, from the charts, many dangers which do not exist, and which we have considered doubtful.

That region of the North Atlantic N. N. E., from the Azores in the charts, is full of these imaginary dangers, which we think are either dead whales or the remnant of wrecks floated there by the Gulf stream, which there loses nearly all its motive power. Were one or two ships of war directed to cruize there and examine whether the dangers did exist or not, it would diminish the anxity of those who pass over that region of the ocean, and would not interfere with their proper duties.

SIR: I have to add to the "Abstract Log" of the United States schooner *Taney*, which has been sent you, some remarks upon the results of parts of our work there recorded—the explorations in the Atlantic, for some of the many rocks and vigias of doubtful existence; deep soundings with the wire; investigations of currents, particularly the under currents, &c.

The *rocks and vigias* searched for, with the positions assigned to them upon the charts, are as follows:

Ashton Rock	Lat.	33°	50′	N., long.	71°	40′ W.
False Bermudas		32	30	"	58	40
Nye's Rock		31	15	"	55	50
Vankenlen's Vigia		31	40	"	38	20
Josyna Rock		31	40	"	23	45
Steen Ground		32	30	"	21	15
Mary's Rock		19	42	"	20	45

Not one of them was found, nor any indications of their existence; on the contrary, every evidence to disprove it.

Our various tracks over and about their reported positions, covering the extent of one and a half degrees of longitude and forty miles of latitude, with the many and deep soundings, from 100 to 800 fathoms, without getting bottom, will be found sufficient, I trust, to satisfy navigators that they have no existence, or at least that those parts of the ocean in which they have been reported to exist are free from all dangers. To the three first mentioned, we gave the most thorough search—to Ashton Rock six days' time, to the False Bermudas eight days, to Ney's Rock likewise eight days. All our tracks were by daylight, as the schooner was always hove to at night while engaged in these explorations. A slight discoloration of water was noticed in the region assigned to Mary's Rock, but no soundings could be got with 500 fathoms. This rock has been previously searched for, with like results, by the United States Exploring Expedition, Capt. Wilkes, and by her Majesty's ship Levin, Capt. Bartholomew. Ashton Rock is placed in a most frequented part of the ocean; there is not a day that some vessel does not pass in the vicinity; and nothing has been seen of it since the first and only report of it in the year 1824. This fact alone should disprove it, independent of our search. I find Mr. Blunt has erased it from his chart of the North Atlantic, as also the False Bermudas, Vankenlen's Vigia, Steen Ground, and Mary's Rock. There are sufficient real dangers in the Atlantic; these imaginary ones should not disfigure the charts; they only serve to harass navigators, turn vessels from their routes, and thus injure commerce. The reports of them by merchant vessels, which seldom take time to examine the appearance of such dangers, can be readily explained. Floating wrecks, large trees, carcases of whales, &c., presenting all the appearance of reefs, have deceived experienced seamen.

Though we did so much less in *deep-soundings* in the Atlantic than expected, owing to the rough weather, bad state of the vessel, and loss of so much wire in the first experiment, nevertheless the proving the ocean to have a depth of more than 5,700 fathoms, (34,200 feet, or more than six statute miles,) as was satisfactorily done in this first trial, is alone of much interest and importance. This vast depth, greater than the elevation of any mountain above the surface, and the greatest depth of the ocean ever yet measured, was reached without finding bottom, in latitude 31° 59′ north, longitude 58° 43′ west, on November 15th, 1849. The wire broke at this length, 5,700 fathoms, at the reel, and this large portion of our supply was thus so early lost. It preserved the exact plumb line throughout the sounding; there was a steady, uniform increase of

weight and tension; no check whatever any instant of its descent; which proves that it could not have touched bottom before the break.* It had been been very carefully measured and marked, so that the *ocean is here deeper than* 5,700 *fathoms* can be relied upon as accurate. This great sounding is within 32 miles of the assigned position of the rocks called the False Bermudas, for which we were then in search, which fact alone should go far to disprove them. We had three choice chronometers, two of which performed with rare excellence throughout the cruise; and being a beautiful clear day, a number of sets of observations were taken in the morning, noon, and afternoon, so that the position was determined with the nicest accuracy.

It proved the finest possible day for this work—the sea so smooth, and hardly a breath of wind. Though we found by trial in the morning a slight surface drift, setting to W. S. W., there was no change of position during the soundings, as proved by the observations—the great weight and extent of the wire, penetrating to such profound depths, seemed to serve as an anchor to keep the little schooner steady.

In all our subsequent work under this head I found the heave of the sea, however slight, was the great difficulty—the lifting of the stern in the pitching motion causing such an immense increase of strain upon the wire, breaking it upon almost every occasion, on reaching about 2,000 fathoms. It is only under the most favorable circumstances, when the sea is very unusually smooth, that this mode of measuring its vast central depths can succeed.

The next subject to which I would refer is our investigation of the *under-currents* of the ocean. I regret we had so few opportunities for these very interesting experiments, but enough has been done to seem to warrant the conclusion that these under-currents are *generally* stronger, setting in various different directions, than those of the surface. I am well aware that there is no mode of testing their *exact* velocity; but that practised by myself, which I will describe, was certainly all-sufficient to show their relative velocity. There may be none so rapid as that mighty oceanic river, the *Gulf Stream:* unfortunately the weather prevented our making these investigations in that interesting region; but in the various parts of the Atlantic in which we succeeded in these experiments, on only two occasions did we find the under-current of less velocity than that running in a different direction above it. The following is the mode practised in testing them:

The surface current was first tried by the usual mode, (a heavy iron kettle being lowered from a boat to the depth of 80 fathoms;) then, for the trial of the under-current, a large *chip-log*, of the usual quadrantal form, the arc of it measuring full four

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* The lead used was but 10 lbs. weight, with a Steelwagon cone fitted to it. Nothing else was attached to the wire, but a small instrument (weighing about 6 lbs) invented by yourself for indicating the depth reached. I had tested this several times to considerable depths, and found its indications correct. Our arrangements for these deep soundings were altogether very complete. It may be well to add an account of them.

We had on board 14,300 fathoms wire, weighing 3,025 lbs., all of the best English steel, of five different sizes, Nos. 5, 7, 8, 10, and 13, (Birmingham gauges.) Every part was tested to bear at least one-third more than the weight which it was calculated to sustain.

An extent of 7,000 fathoms of this, weighing 1,800 lbs. (the remaining 7,300 fathoms, composed of the smaller sizes, Nos. 10 and 13, being stowed away as spare wire,) carefully measured and marked with small copper labels, was linked into one piece and wound upon an iron cylinder 3 feet in length and 20 inches in diameter, the largest size wire being wound first, so as to be uppermost in sounding. Two swivels were placed near the lead, and one at each thousand fathoms, to meet the danger of twisting off by the probable rotary motion in reeling up. The cylinder with the wire was fitted to a strong wooden frame, and machinery attached—fly-wheel and pinions—to give power in reeling up. Four men at the cranks could reel up with ease, with the whole weight of wire out. Iron friction bands, which proved of indispensable importance, were connected, to regulate the rate of the wire in running off the reel. One man with his hand upon the lever of one of these friction bands, could preserve a uniform safe velocity, checking or stopping the wire as required. The whole apparatus could be taken apart and stowed away in pieces; being so large and massive, this was indispensable in so small a vessel as the Taney. When wanted for use, the frame was put together and secured to the deck by iron clamps and bolts, near amidships; the reel hoisted up from below and shipped in its place; a fair leader was secured to the taffrail, being a thick oak plank, rigged out five feet over the stern, having an iron pulley 18 inches diameter fitted n its outer end, and two sheet iron fenders 3½ feet long, of semi-circular shape, fitted under it, to guard the wire from getting a short nip in the drifting of the vessel. The wire was led aft, from the reel, over the pulley, which traversed freely in the fair leader, and passed between these fenders into the water

The time occupied in the descent of the 5,700 fathoms, at the moderate rate it was allowed to go off the reel, using the friction bands, was exactly 1½ hours. I found in the subsequent sounding that two or three men could reel up 1,000 fathoms in 2½ hours, taking time to rub dry and oil it, in passing to the reel, to guard against rust.

feet, and heavily loaded with lead, to make it sink and keep upright, was lowered by a light but strong codline to the depth of 126 fathoms, (the length of the line;) a barrega was attached as a float, a log-line fastened to this barrega, and the rate of motion of this float, as measured by this log-line and the glass, and the direction as shown by a compass, were assumed as the velocity and set of the under-current. No allowance was made for the drag of the barrega, which was always in a different direction from the surface-current. It was wonderful, indeed, to see this barrega move off against the wind, and sea, and surface current, at the rate of over one knot an hour, as was generally the case, and on one occasion as much as 1¼ knots. The men in the boat could not repress exclamations of surprise, for it really appeared as if some monster of the deep had hold of the weight below and was walking off with it. I will cite from the Log several instances of these experiments:

On May 11th, in lat. 24° 43′ N., long. 65° 25′ W., we found a surface-current of one-third knot per hour, setting to the west, and an under current at the depth of 126 fathoms, of one knot, setting W. S. W.—temperature of water at surface 77.3°, at 50 fathoms 77.5°, at 100 fathoms 73.5°. The current felt by the vessel on that day (as deduced from the comparison of the true positions obtained by astronomical observations and chronometers, with those of the dead-reckoning) agreed with this trial of the surface-current, being the same within a fraction, viz: 0.3 knot, westerly. On this day, as noted in the "Column of Remarks," the sea was covered by a species of *medusæ* of a dark red color, spherical in shape, from one-eighth to three-eighths inch in diameter.

On May 12th, at 4 P. M., in lat. 25° 55′ N., long. 64° 43′ W., the surface-current was found to be ½ knot, setting N. N. E., and the under-current (at 126 fathoms) 1¼ knots, setting S. E., being the strong under-current I have alluded to: this was well ascertained by several trials—temperature of water at surface 75°, at 50 fathoms 76°; at 100 fathoms 69°. From this time, 4 P. M. to 8 A. M., the following morning, we experienced a strong current of 1.3 knots per hour, setting N. 14° E., as determined by the observations. While trying the currents in the boat, all hands remaining on board the schooner were employed sounding with 500 fathoms line, but failed to get the temperature at that depth, there being at the time too much swell.

On May 13th, at 5h. 30m. P. M., in latitude 26° 42 N., longitude 64° 4′ W., the surface-current was found to be ½ knot, setting E. by S., the under-current (at 126 fathoms) 1½ knots, setting W. S. W.; at the same time obtained the following temperatures: at surface 77.5°, at 50 fathoms 76.5°, at 100 fathoms 74.5, at 500 fathoms 53°. The current felt by the schooner in the interval from 8 A. M. to 4 P. M., was easterly 0.4 knot per hour, agreeing with the trial in the boat.

On May 14th, in latitude 26° 46′ N., longitude 63° 53′ W., found a slight surface drift, too small to be measured, setting to the westward, and an under-current (at 126 fathoms) of 1¼ knots, setting N. by E. No current had acted on the vessel for the preceding 16 hours, the dead reckoning agreeing with the observations.

On this day, the sea being pretty smooth, we tried soundings with the wire, and got 1,050 fathoms without bottom, and we succeeded in getting, by one of the Six's self-registering thermometers, (which came up uninjured by the immense pressure,) the temperature at that great depth, which was 49°, while at the surface it was 77°.

On 18th May, at 9 A. M., in latitude 30° 6′ N., longitude 67° 56′ W., found a surface current of ½ knot setting N. W. by N., and a very slight under current (at 126 fathoms) not more than one-sixth knot setting N. E. No current was felt by the vessel during that day, but during the preceding night ½ knot per hour, setting N. W. Being calm and pretty smooth, we sounded during this day to the depth of 2,050 fathoms, when wire broke without reaching bottom. The temperature at surface 70°, at 100 fathoms 65°. The trial of currents on this day was one of the two occasions which I have alluded to, on which we found a less under-current than that above it.

On the 29th May, at 11 A. M., in latitude 33° 58′ N., longitude 72° W., found the surface-current ½ knot, setting S. E., and an under-current (at 126 fathoms) of 1 knot, setting W. N. W.; temperature at surface 71°, at 50 fathoms 70.5°, at 100 fathoms 67°. We were set during this day, as determined by the afternoon observations, to the eastward, at the rate of ½ knot per hour. On this, which happened to be the last occasion of these experiments, I tried the current at the depth to which the kettle was lowered—80 fathoms—which it would have been better to have always done; I found it tended in the same direction as that at 126 fathoms, (counter to the surface-current,) but at so small a rate that it could hardly be measured—not more than 1-10 knot per hour—the float moving at only this small rate, being but one-tenth of the velocity at which it had moved just before when trying at 126 fathoms. This indicates that the kettle had just penetrated the under-current; and thus, by this means, it would appear practicable to measure the depth of the surface-current, or its point of contact

with the counter under-current. Such experiments in the *Gulf Stream* would be particularly interesting.

In connection with this subject of under-currents, *or sub-marine streams*, I may hope that you will find our record of the temperatures of the ocean, taken, according to instructions, at every 30 miles, to the depths of 100 and of 50 fathoms, and the surface temperatures taken every hour, will serve to throw more light in this new world of research, of such great interest and importance in terrestrial physics.

The column of currents, in the Abstract Log, gives the currents of practical importance to navigation, those of the *surface* for every eight hours, or as often as ascertained by the observations; the difference between the true position, as determined by them, and that deduced from the log or dead-reckoning, being held as the effect of current. Our dead reckoning was with this view kept with unusual care and nicety. I found the night observations could not be depended upon sufficiently to determine currents, but the early morning or evening twilight often afforded beautiful opportunities; the horizon so well defined, and the larger planets and stars so clear and brilliant. You will notice we met with the usual variable currents in crossing the N. Atlantic in about latitude 31°, region of variable winds: between the longitudes, however, of 48° and 57° we met with a steady current of about one knot an hour, setting to northward and westward. Recrossing in about latitude 17°, we experienced daily the great *Equatorial Stream*, setting to the westward at the average rate of ½ knot per hour. This is within the region of the *Trade Winds*, and here we often noticed the upper light clouds, the *cirri*, moving from the westward, while the lower strata moved with the prevailing winds from the eastward, thus indicating the existence of an upper current of winds, counter to the *Trades*.

We first crossed the *Gulf Stream* on the 31st October; we struck into it in latitude 37° 22′ N, longitude 71° 26′ W., as indicated by the temperatures of the water, which were as follows:

8	A. M.	water at	surface	66°,	air 54°
9	"	"	"	73°,	" 53°
10	"	"	"	76°,	" 55°
11	"	"	"	77°,	" 56°

Making a S. S. E course good, at the rate of six knots an hour. 77° was the highest temperature found in the Stream in crossing it this time; we were set by it to the eastward at the rate of 3.6 knots per hour. We got out of it, judging from the water getting back to 70°, in lat. 36° 16′ N., long. 70° 57′ W., bearing from the point of entrance S. 20° E., distant 71 miles. This 71 miles would, therefore, appear the breadth between those points of latitude and longitude; no doubt, however, the surface breadth varies considerably, as also the *velocity*, affected by the winds and other causes unknown. We encountered the usual bad weather, and suffered much in our little craft from a very heavy, irregular, and topping sea, which kept the decks flooded. I extract from the column of "*Remarks*" on that day: Oct. 31st. *On the western edge of Gulf Stream*—from 4 A. M. to 8 A. M., fresh with heavy squalls, accompanied by thunder, lightning, *hail*, *snow*, rain and appearances of waterspout; columns of dense vapor rising from the sea to the clouds," &c. "The same bad weather continued throughout the day. From 8 to midnight hail, with rain, accompanied by squalls and a tremendous sea."

Recrossing this *stream* on our return, on May 30th, we entered it in lat. 35° 30′ N., long. 72° 35′ W., having a slight touch of the same weather, "squalls with rain, thunder and lightning." The temperature stood as follows:

	Water at surface.	*At 50 fath.*	*At 100 fath.*	*Air.*
8 A. M.	71.8°	71.8°	67°	70°
9 A. M.	73°			
10 A. M.	75.5°			
11 A. M.	78.5°			
12 A. M.	78.5°	77.4°	72.5°	76°

79° was the highest temperature found, when at same time it was 77° at 50 fathoms, and 74 at 100 fathoms. Its velocity, as felt by us in crossing this time, was 2.5 knots per hour, setting N. 77° E. We got out of it lat. 36° 42′ N., long. 72° 10′ W., bearing from the point of entrance N. 16° E., distant 78 miles; 78 miles, therefore, appears the breadth between these points of latitude and longitude. The temperatures on leaving it stood as follows, the air being 66°:

3 A. M., water at surface 78°.
4 A. M., water at surface 74°, at 50 fathoms 70° at 100 fathoms 64°
5 A. M., water at surface 72°.
6 A. M., water at surface 71°

Heading during these three hours N. W. by N. at the rate of three and a half knots an hour. At 9 A. M. the water stood at surface 69.5°, at 50 fathoms 68.5°, at 100 fathoms 56.5°. By 1 P. M. the temperature at surface had fallen to 63.5°, at 50 fathoms to 58.5°, at 100 fathoms 58°, the temperature of the air being 68°. When on soundings next day, June 1st, in lat. 39° N., long. 70° 30′ W., the water showed as low as 51° at surface, and maintained an average temperature of 53° until we reached New-York. This is a difference of 28° from the adjacent Gulf Stream. Shoals of porpoises and black fish were seen by us in the hot waters of the stream. We saw very little gulf or sea-weed (*fucus natans*) in it, but much on its outer edge. While mentioning this weed I may here remark that we looked in vain in the region assigned to the *Sargasso Sea* for the great fields of it which had been reported. Small patches of five or six feet, generally arranged in long parallel lines in the direction of the wind, were seen daily in crossing the Atlantic till we reached the longitude of 28°, when it disappeared altogether. My frequent examinations of this weed satisfy me that wherever it may originally come from, it feeds and grows upon the waters of the sea, which is certainly not more strange than the plant which feeds upon the air.*

We discovered the *hot waters of the Gulf Stream* extending as far east as 72° 10′, in a latitude so far south as 33° 30′. The column of water-temperatures in the "Abstract," from May 23d to 29th, while engaged in the search for Ashton Rock, will satisfy you of this interesting and important fact; for you will notice that whenever we reached that longitude, in our various tracts between the latitudes of 33° 30′ and 34° north, we experienced a sudden change of as much as 5° and 6° in the surface temperature—70° to 76°. This must be a branch or offset from the Gulf Stream, being so far to the eastward of the limits hitherto given to it *in those latitudes*.† We first noticed this extraordinary change of temperature on the 23d—the temperature of surface-water rising on that day from 71.5° to 79°. I cite from the Abstract:

Midnight, commencing 23d May, latitude 32° 35′ north, longitude 73° 24′; surface water 71.5°, at 50 fathoms 71.5°, 100 fathoms 67°.

8 A. M., latitude 32° 58′ north, longitude 73° 36′, surface-water 73°.

9 A. M., latitude 32° 59′ north, longitude 73° 38′, surface-water 75°, at 50 fathoms 73.5°, 100 fathoms 70°.

3 P. M., latitude 33° 03′ north, longitude 73° 52′, surface-water 79°.

The current at 9 A. M. was found by trial to be 1 knot per hour, setting W. N. W. and the under-current (at 126 fathoms) one knot setting to the E; the current felt by the vessel (as determined by comparison of results of observations and dead-reckoning) was 1.5 knot per hour, setting westerly: this was between 8 A. M. and 4 P. M. The variations of temperature of the water, recorded on the next day, (24th of May,) in latitude 33° 25′, longitude 72° 40′, are worthy of notice—the sudden fall of 3½ degrees in one hour, from 6 to 7 P. M., 75.5° to 72°, while standing to the northward and eastward, and the rise again the next hour to 75°, made me suspect the possibility of a *shoal*, so that I put back, found the place again, and sounded with 300 fathoms line, but got no bottom. It being thick squally weather, I could not attempt deeper soundings.

The column of *specific gravity* of sea-water calls for some remarks. Our measurments by the hydrometer show that in some parts, if not in most parts of the ocean, the water is specifically *lighter* at depths than at surface, when reduced to like temperature—the correction for this difference being applied. I found on one occasion the following large difference: On December 8th, at surface 1028.6, (distilled water as standard, held at 1000,) at 200 fathoms 1028.4, at 500 fathoms 1027.2, all at 60° temperature; this was in latitude 31° 42′ north, longitude 38° 12′ west. The specific gravity generally found at surface appears about 1028.4 at 60° temperature; and this specific gravity at surface appears, according to our record, more variable than at depths.

The greatest *transparency* of the water observed, as found in its column, was seventeen fathoms, being able to see a large lead, painted white, at that depth. This was in latitude 21° 4′ N., longitude 66° 36 W.

The column of *barometer* contains the records of the improved marine mercurial barometer, got from Tagliabue, in New-York, which proved to be an excellent instrument, and most valuable to me, never failing to warn of an approaching gale. The Aneroid, though not noticed in the Abstract, was regularly recorded in the Log with the Mercu-

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* It grows on the Andros Islands.—G. W. B.

† Lieut. Walsh is mistaken in supposing that he made this discovery; this is due, as we have said in the introduction to the article on the Gulf Stream, to the late Lieut. George M. Bache, U. S. N., in 1846, then on the U. S. Coast Survey.—G. W. B.

rial, every four hours during the cruise. This may serve as a good test of its performance. It was set with the *mercurial* on leaving New-York in October. It commenced at once to differ, indicating higher; and, though its daily fluctuations agreed well, this difference steadily increased until, by the time we got back to New-York seven months after, it had reached as high as six-tenths of an inch above it; thus acquiring an error of very nearly one-tenth of an inch a month. This leads me to doubt whether this ingenious instrument can ever be sufficiently trusted to take the place of the mercurial, though it is so much to be desired.

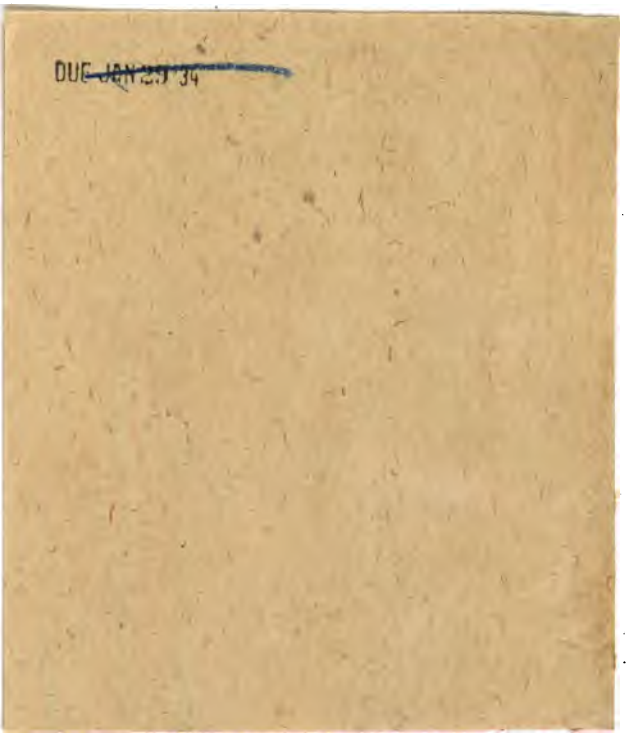
The observations for the *variation of the compass* could be taken but seldom with exactness, and therefore appear but seldom in the "Abstract;" the needle being generally kept by our jumping little schooner in too unsteady a state for correct azimuths.

In conclusion, I must express my regrets that the most important part of the "Instructions" was prevented being carried out by the bad condition of the schooner, proving on overhauling at Porto Praya, quite unseaworthy. I allude to the investigations of the currents about Cape St. Roque, and of the volcanic region of the South Atlantic near the equator. But I sincerely trust that the work will not be allowed to stop here—that it will be continued under your instructions, in connection with your "*Wind and Current Chart*," as has been authorized by Congress. The employment of three suitable vessels was recommended by the bill, but one has yet been employed, and that quite unsuitable in size and condition. A vessel of but one hundred tons, as is the "Taney," independent of being too unstable for the observations and the soundings, cannot carry officers and men enough for the incessant and laborious work required, nor provisions and water enough to keep the sea for long periods of time, as is essential on this service.

I have the honor to be, very respectfully, your obedient servant,

J. C. WALSH, Lieut. U. S. N.

To Lieut. M. F. MAURY,
Sup't National Observatory Washington.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